GAZETTEER

OF THE

PUNJAB

ROVINCIAL VOLUME.

1888-9.

Compiled and published under the authority of the
PUNJAB GOVERNMENT.

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PREFACE.

THE period allowed by the Punjab Government for the compilation of the *Gazetteer* of the Province was fixed at twelve months, within which time the Editor was to compile, publish in draft, revise, and publish in its final form a separate volume for each of thirty-one districts. It may readily be supposed that the scheme did not include the preparation of an account of the Province, brief but complete in itself, which, condensed from the more detailed district accounts into the limits of a single volume, might properly be called the Provincial Volume of the series.

At the same time it was found, as the compilation of the several district volumes went on, that there were certain subjects which could not properly be treated in them, and which it would be scarcely possible to notice at all, unless some portion of the series assumed a more or less general form. Geology could not be discussed intelligently save for the Punjab as a whole; the great railways and canals pass through many districts; some of our public institutions belong to the Province, rather than to the district in which accident has placed their buildings; and so forth.

Again, while the *Gazetteer* was in process of compilation, the Punjab Administration Report for 1882-83 appeared. Circumstances combined to give it a very special character. Not only did it include those sections of the report which are ordinarily written only every five years, but it was the first report for ten years in which these sections had been included. The report on the Census of 1881, moreover, had just been published. Accordingly much pains had been taken to render the more permanent portions of the Administration Report complete in themselves, and of lasting interest and value. These portions have been transferred almost bodily to the present volume.

Thus the Provincial Volume of the *Gazetteer* series is in no manner or degree a *Gazetteer* of the Province. It consists of a series of fragments, complete in themselves, so far as the necessary limitations of the work furnish, but covering only a small portion of the field which a complete Gazetteer should embrace. The *lacunæ* lie in the list of subjects treated, rather than in the treatment of individual subjects. The Volume will be a useful, and indeed a necessary, supplement to the district volumes of the series ; while some portions of it are not wholly devoid of general interest.

Acknowledgments are due to the following gentlemen, who have contributed the sections noted against their respective names :—

Description of the Province	...	MR. DENZIL IBBETSON.
Geology	...	MR. H. B. MEDLICOTT.
History	...	MR. W. R. H. MERK, C.S.I.
Statistical and Social	...	MR. DENZIL IBBETSON.
Land Tenures	...	MR. D. G. BARKLEY.
Industries and Manufactures	...	MR. BADEN-POWELL, C.I.E.
System of Public Instruction	...	MR. PEARSON.
The Punjab University	...	MR. E. W. PARKER.
Literary Societies	...	" "
Punjab Railways	...	CAPT. PITT, R.E.
" Canals	...	MR. CATTON.

The Volume, though completely compiled by the Editor, has been passed through the press by Mr. M. W. Fenton.

THE EDITOR.

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PUNJAB—PROVINCIAL VOLUME.

CHAPTER I.

THE PROVINCE.

Chapter I.

The Province.

Introductory.

The Punjab with its Feudatory States covers an area of 144,436 square miles, and includes a population of 22,712,120 souls, or one-tenth of the whole area, and one-eleventh of the total population of the Indian Empire. It numbers among its inhabitants one-fourth of the Mussalmán, one-twentieth of the Hindu, and eleven-twelfths of the Sikh subjects of the Queen. Together with Kashmir, which lies to its north, it occupies the extreme north-western corner of the Empire, and comprises all of British India north of Sind and Rájpútána and west of the River Jumna. Lying thus in the angle where the Himalayas, which shut in the peninsula to the north, meet the Sulemáns which bound it on the west, and situated between Hindústán and the passes by which alone access from the great Asian Continent is possible, it is in a very special sense the frontier province of India, and guards the gateway of that Empire of which it was the last portion to be won. The immigrant swarms which have from time to time poured into India, and the conquering armies which have from time to time invaded it, have alike crossed the plains of the five rivers from which the Province takes its name; while its great eastern plains, which part the waters that flow on the one hand into the Indian Ocean and on the other into the Bay of Bengal, have ever formed the battlefield of Northern India. Nor is its present interest inferior to its historical importance. Stretching northwards up to and beyond the great peaks of the Central Himalayas, and embracing the Tibétan valleys of Láhul and Spiti, it includes in its eastern districts a portion of Hindústán, on its southern border it encroaches upon the great prairies of Rájpútána, while its trans-Indus territory belongs to Afghánistán and Bilúchistán rather than to India in every respect other than political. And the diversity which marks its physical and geographical aspects is no less characteristic of the races which inhabit it, of their origin, language, beliefs, customs and social structure.

Position, Shape and Size.

The Province lies between 27° 39′ and 35° 2′ north latitude and 69° 35′ and 78° 35′ east longitude. Its shape is something between a dice-box and an hour-glass, the axes crossing at Lahore, and the longer axis running nearly east by south. The length of the longer axis is about 450, and of the shorter 160 miles; the eastern base measures some 370, and the western some 540 miles. The constriction in the middle is due to the fact that the northern boundary runs up into the hills of Chamba and Kullu in the east and of Hazára in the west, on either side of the kingdom of Kashmir; while to the south the Province stretches down the fertile banks of the Jumna to the east, and of the Indus to the west,

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Boundaries.

between which two rivers the arid deserts of Rájpútána extend northwards to within a hundred miles of Lahore.

Along the northern border of the Punjab, Himalayan ranges divide it from Chinese Tibet and Kashmir. To its west and north-west lies Afghánistán, from which it is separated on the west by the Sulemán mountains, and on the north-west by the ranges which run from the eastern extremity of the Sufed Koh north-east to join the Himalayas, and south-west to meet the Sulemáns. In the southern extremity of its western border the Sulemán range divides the Punjab from the Kelat territory and Bilúchistán. To its south lie Sind, Rájpútána, and the Mathra district of the North-Western Provinces; while on the east the rivers Jumna and Tons separate it from the same Provinces, and on the north-east a mighty Himalayan range shuts it off from Chinese Tartary.

Political Divisions, Area, and Population.

The Punjab includes two classes of territory, that belonging to the British crown, and that in the possession of the 34 feudatory Chiefs of the Province, almost all of whom pay tribute in some form or other, and all of whom are subject, more or less, to control by the Local Government. The area and population of these two divisions are shown in the margin. Of the total area of the Province, some 26,300 square miles consist of mountainous or elevated tracts, and the remainder of plains. Of the 107,010 square miles included in

Territory.	Square miles.	Population.
British	107,010	18,850,437
Native States ...	37,426	3,861,683
Total Province ...	144,436	22,712,120

British territory, 11,170 are irrigated, 36,656 are cultivated, 36,706 more are classed as culturable, and would repay the labour of the husbandman were means of irrigation available, while the remaining 33,648 consist of inhospitable mountain sides or unculturable waste. The Forest Department has under its operations an area of about 3,700 square miles. Similar figures are not available for the Native States. British territory is divided (Statistical Table No. 1) into 32 districts, which are grouped under ten divisions, and each of which, except the sanitarium of Simla, comprises as large an area and population as can conveniently be controlled from its head-quarters. The several tracts included in this territory are described below.

The dominions of the 34 Native Chiefs (Statistical Table No. 2), vary in size and importance, from the principalities of Patiála and Baháwalpur, with areas of 5,500 and 17,300 square miles, and populations of 1,500,000 and 600,000 respectively, and ruled over by Chiefs subject only to the most general supervision, to the tiny State of Darkuti, with an area of 4 square miles and a total population of 590 souls, whose ruler is independent in little more than the name. They may be grouped under three main classes. The Hill States, lying among the Punjab Himalayas, and held by some of the most ancient Hindu Rájpút families in the world, include Chamba, Mandi, Suket, and the 20 Simla States, of which last only four, namely, Náhan, Biláspur, Bashahr and Nálagarh, exceed an area of 250 square miles, or a population of 17,500. Along the western half of our southern border, and separated from British

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Political Divisions, Area, and Population.

territory by the Sutlej, lies the Muhammadan State of Baháwalpur, consisting of the Left Sutlej Valley and a broad strip of the Rájpútána desert. The remaining States, including the possessions of all our great Jat Sikh feudatories, lie wholly east of Lahore, and, with insignificant exceptions, occupy the centre of the eastern plains of the Province.

Mountain Systems.

The mountain regions of the Punjab naturally fall under four separate groups. To the north-east of the Province lies the Himalayan system of the Punjab proper, with the fringing range of the Siwáliks at its foot. In the south-eastern corner of the Punjab the Aravali system sends out insignificant outliers which run across the Gurgaon and Delhi districts and strike the Jumna at Delhi. The lower portion of the western frontier is constituted by the great Sulemán chain; while the north-western corner of the Province lies among and within a tangled series of peaks and ranges, marking the point of junction of the Himalayas of Kashmir, the Sufed Koh, and the Sulemáns, and is cut off by the Salt Range and its trans-Indus continuation from the great plains which lie to the east and south. The first and last of these four groups are separated by Kashmir territory, which, from the Himalayan State of Chamba on the east to the Jhelum on the west, stretches down to and includes the foot of the mountain ranges.

The Sulemáns.

The Sulemán mountains run almost due north and south along the western border of the Province for between 300 and 400 miles. They consist of several parallel ranges of barren mountains, between which lie valleys that are fertile only by comparison. The frontier of British India runs sometimes at the foot and sometimes along the crest of the easternmost of these ranges; and the mountains themselves, which are inhabited by independent or semi-independent tribes of Patháns and Bilúchís, belong to the Punjab in little more than a geographical sense.

The Aravalis.

The Aravalis, which run through the Gurgaon and the south of the Delhi District, consist of low ranges of insignificant hills covered with brushwood, and are interesting chiefly from a geological point of view, as, with the exception of the isolated peak of Karána in Jhang, they form the northernmost extremity of the Peninsular rock system, so distinct from the later formations of the Himalayas.

The Himalayan System.*

The mountain system of the Himalayas, so far as it concerns the Punjab, consists primarily of three great ranges running in a generally north-westerly direction from the head-waters of the Sutlej to the Indus; the Westerly Himalayas or Zanskár or Bára Lácha range, the mid-Himalayas or Pír Panjál range, and the outer or sub-Himalayas. From these three great ranges spring numerous minor ranges as ribs from a backbone, the whole forming a confused system of mountain chains and valleys, the breadth of which is some 90 miles at its eastern extremity, from Láhul to the Siwáliks of Hoshiárpur, and some 150 miles measured at its western extremity across Kashmir.

* This account of the three great Himalayan ranges is mainly condensed from General Cunningham's "Ladakh."

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The Western Himalayas.

The Western Himalayan or Zanskár or Bára Lácha range separates the valley of the Upper Indus which lies to its north from the mountain-basins of the five Punjab rivers. It runs from the sources of the Sutlej along the northern borders of Kanáwar in Bashahr, Spiti, Láhul, Pángi (in Chamba) and the Kashmir Valley, till pierced by the Indus at the base of the mighty Nanga Parbat. Thence it passes on to join the Pámír and Hindu Kúsh near the sources of the Kuner and Gilgit rivers. It separates the Aryans of India from the Botís of Tibet, and the cold, dry, treeless steppes of Central Asia from the luxuriant humidity of India. The average height is 19,000 feet, or greater than that of the Andes; the average height of its peaks is 20,770 feet, and that of its passes 15,700 feet. Its snow-line lies at 18,500 feet on its southern and at 19,000 feet on its northern face.

The Mid-Himalayas.

The Mid-Himalayan or Pír Panjál range divides the valleys of Spiti, Láhul and Kashmir on the north from that of Kullu, Plách and Chamba on the south, and terminates on the Indus at the Hazára border in the celebrated peak of Mahában, though the Swát range may perhaps be considered its trans-Indus continuation. Its general direction is north-west, and it is divided into three well-marked sections by the great rivers which pierce its chain. The easternmost or Bashahr range is an offshoot of the Western Himalayas, and extends for a distance of 60 miles from lofty Jamnotri to the Sutlej below Ghatul. Beyond the Sutlej it is continued by the Láhul range, which runs for 160 miles to the great southward sweep of the Chenab in Kishtwár (Kashmir). Thence the Pír Panjál runs for some 180 miles to the great southward sweep of the Jhelum at Muzaffarabad, and across the Jhelum and Hazára districts to the Indus at Darband. The average height of the peaks is 19,000, of the passes 15,520, and of the chain 17,000 feet in the Bashahr and Láhul sections. The Pír Panjál range is probably some 5,000 feet lower. The snow-line is at 16,000 feet on the northern and 17,000 feet on the southern face.

The Outer-Himalayas.

The outer or Sub-Himalayas stretch in a north-westerly direction, through Suket and Mandi and between Kángra and Chamba, for a distance of some 300 miles, and terminate on the Indus at the Hazára border in the well-known peak of Gandgarh. Starting from the bend of the Beas at Mandi, they are pierced by the Ravi, Chenab, Púnch and Jhelum rivers, which divide them into five distinct sections. The easternmost section is the precipitous range of the Dháola Dhár or White Mountains, which, lying between the Beas and the Ravi, form the natural boundary between Kullu and Mandi and between Kángra and Chamba, and is the highest portion of the range, reaching an average of 15,000 feet. Its length is some 80 miles, and it includes the hill stations of Dharmsála and Dalhousie. The second portion, some 55 miles in length, lies between the Ravi and Chenab, and shuts in Chamba and Badrawár (Kashmir) to the south. Its average height may be put at 12,000 feet. The central portion of the range is known as the Ratan Panjál; it stretches from the Chenab to the southern bend of the Púnch River, for a distance of some 80 miles, and ranges in height between 7,700 and 11,000 feet. The fourth section, some 25 miles

in length, runs from the Púnch River to Dhangali, the ancient Gakkhar capital on the Jhelum. The westernmost division of the range runs for 70 miles between the Jhelum and the Indus, and attains a height of above 17,000 feet. The Outer-Himalayas have no perpetual snow.

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The Outer-Himalayas.

All those great Himalayan chains, terminating on the Indus at or about the Hazára border, are bound together by two considerable ranges which, springing from the western extremity of the Western Himalayas, run southwards down either side of the Kághán Valley and the Hazára district, the more eastern striking the Jhelum and following its course to merge with the Murree Hills; while the more western, which separates the Himalayas from the Hindu Kúsh, terminates on the Indus, where it meets the Hazára border. At the opposite or eastern extremity of the system the Cis-Sutlej Himalayas, in which the sanitarium of Simla is situated, occupy a corresponding position, running in a generally south-westerly direction, and separating the head-waters of the Sutlej from those of the Jumna and Ganges.

The Hills of Simla and Hazára.

The Siwáliks are an insignificant range of low hills which, rising abruptly from the plains, skirt the foot of the Himalayas from the Ganges to the Beas. At the widest part, as they approach the Sutlej, they are some 10 miles broad. Between them and the Himalayas proper lie a series of fertile valleys known as *Dúns;* and the hills themselves are clothed with forest timber of some value, save at their western extremity, where they degenerate into little more than sand-hills.

The Siwáliks.

The connecting link between the Sulemáns on the west and the Himalayas on the north still remains to be described. The Outer-Himalayas, crossing the Jhelum, run up the eastern boundary of the Ráwalpindi district. There they and the Mid-Himalayas meet on the banks of the Indus in a confused mass of mountains, among which the Hazára district lies, and stretches out the Kághán Valley, like a huge arm, to where the Indus pierces the Western Himalayan range at the foot of Nanga Parbat. The curved ranges which connect the extremities of the Mid-Himalayas and of the Sufed Koh enclose to the north the plain which constitutes the Peshávar district; while the northern continuation of the Sulemáns runs up the western border of Bannu and Kohát to meet the Sufed Koh, and throws out eastwards a series of parallel spurs which cover the whole of the Kohát district. The circuit is completed by the Salt Range, which, starting from opposite the point where the Mid-Himalayas abut upon the Jhelum, runs first along the right bank of the river, then westwards across the Shahpur and Dera Ismail *thal* to the Indus, where it turns down the right bank of that river through the Bannu District, and follows the boundary between Bannu and Dera Ismail Khan till it joins the Sulemáns. Rising abruptly from the river and the great desert which lie to the south of it as a steep rocky range of from 2,000 to 5,000 feet in height, the Salt Range of Jhelum and Shahpur falls away imperceptibly to the north into a great table-land enclosed by the range itself, the Hazára Hills, and the River Indus, crossed in every direction by chains of low hills, and cut up by

The Salt Range and the Peshávar Hills.

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the streams which issue from them into innumerable ravines. It is this table-land which constitutes the districts of Jhelum and Ráwalpindi.

The River System.

The Himalayas which stretch from Northern Punjab and Kashmir far away into Tibet give birth to seven great rivers, which, after pursuing their courses for, in some cases, many hundreds of miles among snow-clad mountain-ranges, debouch on to the plain country, and traverse the Punjab in a generally southerly direction on their way to the ocean. The hills once fairly left behind, their fall seldom exceeds two feet in the mile, and their course is in consequence exceedingly inconstant, varying, often considerably, from year to year. Thus in the process of time each stream has cut for itself a wide riverain lying well below the level of the surrounding plains, the banks of which mark on either side the extreme limits of the river's excursions. Within these low lands, over the whole of which the stream has at some time or other flowed, the river winds its way in a narrow and ever-shifting channel. In the winter the stream is comparatively small; but as the mountain snows melt under the approach of the Indian summer, the waters rise and overflow the surrounding country, often to a distance of several miles on either bank. As the cold returns at the close of the rainy season, the waters recede, leaving wide expanses of fertile loam or less fertile sand, moist for the hand of the cultivator.

The Jumna.

The Jumna and its tributary, the Tons, form the greater portion of the eastern boundary of the Province, along which they flow almost due north and south for a distance of some 220 miles.* A few miles to the west runs the water-shed between the Indian Ocean and the Bay of Bengal, which forms the backbone of extra-peninsular India.

The Area of closed drainage.

West again of this line lies a peculiar area of closed drainage intermediate between the basins of the Jumna and Sutlej, into which the Márkanda, Saraswati, Ghaggar and other hill streams pour their waters; while the last-named river affords the only outlet, and, passing away westwards into Rájpútána, itself gradually dwindles and finally disappears in the arid wastes of that province. All to the west of this area, as well as the whole mountain region of the Punjab, belong to the Indus system.

The Indus.

The Indus itself enters the Province at Torbela, on the Hazára-Pesháwar border, cuts off the hill tract, presently to be described, of the Pesháwar and Kohát districts from the Punjab proper, pierces the Salt Range at Kálábágh, and runs almost due south along the whole western frontier of the Province at a distance of from 15 to 30 miles from, and parallel with, the Sulemáns. The only affluent of any importance that it receives within the Province on its right bank is the Kabul River, which, with its tributaries, the Swát and Bára, drains the Pesháwar Valley; for the scanty rainfall of the Sulemáns is insufficient to feed anything more than hill torrents of intermittent flow. From the east, however, it

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* All distances given in this and the next seven paragraphs are measured from point to point, and not along the course of the stream.

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receives the combined waters of the Jhelum, Chenab, Ravi, Beas and Sutlej, the five great rivers which give the Punjab (*panj áb*, or "five waters") its name, and which traverse its plains, lying in that order from west to east.

The Sutlej.

The Sutlej, rising in Chinese Tartary, enters the Province in the State of Bashahr, and, flowing through the territories of our hill feudatories, debouches on the plains at Rúpar in the Umballa District. Thence it flows due west for 120 miles as far as Ferozepore, where it receives the waters of the Beas, and thence south-west for some 270 more miles, till, joined by the combined Ravi, Chenab and Jhelum, it pours the united waters of the five rivers into the Indus opposite Mithankot, some 70 miles above the Sind border.

The Chenab.

The Chenab takes at once its name and its origin from the twin streams of the Chandra and Bhága, which drain the Himalayan valley of Láhul. Traversing Chamba and south-eastern Kashmir, with a generally western course, it re-enters the Punjab at the middle point of its northern border, just below the town of Jummoo. Thence it runs, first to the south-west, but gradually changing to the south, for some 300 miles to join the Sutlej about 40 miles above the confluence of the latter with the Indus, receiving the waters of the Jhelum at about the midway point of its course in the plains, and those of the Ravi some 50 miles lower down.

The Beas and Ravi.

Between the Sutlej and Chenab flow the smaller streams of the Beas and the Ravi. The former rises in the Kullu Himalayas, runs westwards through Mandi and Kángra, enters the plains at the north-western extremity of the Hoshiárpur District, and joins the Sutlej after a south-western course of some 70 miles from its leaving the mountains. The latter rises in Chamba, enters the plains some 15 miles west of the Beas, and flows 260 miles to the south-west, to join the Chenab about 90 miles above the confluence of that river with the Sutlej.

The Jhelum.

Finally, the Jhelum, rising in Kashmir, flows due south along the boundary between that kingdom and the Hazára District for a distance of 100 miles, and enters the plains at the town of Jhelum, whence it flows south-west for 100 miles as far as Shahpur, and then 70 miles further in a southerly direction till it joins the Chenab 150 miles above its confluence with the Sutlej.

The Distribution of the Punjab Rivers.

Thus, if the northern edge of the Punjab plains be produced across the Salt Range tract to strike the Indus at Attock, the points at which the rivers cut that line are as shown in the margin. But while the Jumna and Indus, which lie to the extreme east and west, run almost due south, the five rivers which flow between them all tend to the south-west to join the Indus before it leaves the Province; so that by the time they reach the longer axis of the Punjab, which runs through Lahore from near the eastern extremity of the line just discussed, the Sutlej has left the Jumna, has approached the Ravi, and has absorbed the Beas altogether, while all five rivers have approached nearer to the Indus; and the distances

Jumna to Sutlej	... 80 miles.	80
Sutlej to Beas	... 75 "	155
Beas to Ravi	... 20 "	175
Ravi to Chenab	... 50 "	225
Chenab to Jhelum	... 35 "	260
Jhelum to Indus	... 110 "	370

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Jumna to Sutlej	... 170	miles.	170
Sutlej to Ravi	... 40	„	210
Ravi to Chenab	... 70	„	280
Chenab to Jhelum	... 50	„	330
Jhelum to Indus	... 60	„	390

measured as before are shown in the margin. And of the southern border of the Province, the whole eastern half, some 275 miles in length, which forms the southern base of the area of closed drainage already described, is unbroken by any river worthy of the name.

The Punjab Plains.

South of the great Himalayas stretch the great plains which constitute by far the larger portion of the Province. If we except the Himalayan and Salt Range tracts, the Punjab presents, from the Jumna in the east to the Sulemáns in the west, one vast level, unbroken save by the wide eroded channels within which the great rivers ever shift their beds, by the insignificant spurs of the Aravali mountain system in the south-eastern corner of the Province, and by the low hills of Chiniot and Karána in Jhang. From the water-shed of the Jumna the slope is uniformly westwards towards the Indus basin, broken locally by the successive steps which part the catchment-basins of the Punjab rivers, and which, often almost imperceptible to the eye, always lie close to the right bank of the channel. From the foot of the hills the plain country slopes southwards till it approaches the southern border of the Province, when it begins to rise again towards the peninsular area. The lowest contour runs from Delhi west by north, a little south of Rohtak and Hissar, and bifurcates between Hissar and Sirsa, the northern branch going north-north-west along the Himalayan spill to the south of Lahore, while the southern branch curves to the south-west along the Aravali spill to the west of Bikanír. The combined result of these two slopes is a fall in a south-westerly direction, at right angles to the mountain ranges and parallel with the general course of the rivers; but the fall is exceedingly gentle, seldom exceeding two or three feet in the mile.

The whole of these vast plains is of alluvial formation. Stones are unknown, save at the immediate foot of the hills; micaceous river-sand is to be found everywhere at varying depths; and the only mineral is nodular accretions of limestone (*kankar*), which are produced *in situ*. The soil is a singularly uniform loam; true clay is almost unknown; and the quality is determined chiefly by the greater or smaller proportion of sand present. In the local hollows and drainage lines the constant deposit of argillaceous particles has produced a stiff tenacious soil, singularly adapted to rice cultivation; while in the beds of the great rivers, and on the wind-fretted water-sheds, pure sand is commonly found. The great *thal* which lies between the Jhelum-Chenab and the Indus, bordered on the south by the Rájpútána desert, and on either side by the two largest of our rivers, consists of a series of rolling sand-hills formed by the wind, which run parallel to the great break-water of the Salt Range, and are separated by valleys in which the original surface is exposed. In parts, and especially where local conditions raise the level of the water-table, the salts natural to the soil have been concentrated on the surface by continuous evaporation, and have covered the ground, often for miles together, with a saline efflorescence known as *reh*, which is fatal to vegetable life. But where neither *reh* nor sand is present, the soil is uniformly fertile, if only the

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The Punjab Plains.

rainfall be sufficient, or means of irrigation be available. Throughout the greater part of the western plains of the Punjab, however, neither of these conditions is satisfied, and wide steppes of intrinsically fertile soil, locally known as *bárs*, are useful only as grazing-grounds for herds of camels and cattle. The depth of water from the surface varies greatly. Throughout the broad riverains and immediately below the hills it ranges between 10 and 30 feet; but the depth increases with the distance from the rivers and the hills, and in many parts of the Province rises as high as 150 to 200 feet, while the water, when reached, is too often so brackish as to be harmful to both animal and vegetable life. The natural divisions of the Punjab plains are more particularly described below.

Rainfall.

The Punjab enjoys two well-marked seasons of rainfall—the monsoon season, which brings it by far the greater portion of its annual supply, which lasts from the middle of June to the end of September, and upon which the autumn crops and spring sowings depend; and the winter rains, which fall early in January, and though insignificant in amount affect very materially the prospects of the spring harvest. The table in the margin shows the most recent statistics of rainfall for certain selected stations, the figures being corrected averages of all past records which can be depended upon.

Station.	Inches of annual rainfall.	Tract.
Dalhousie	70·42	
Dharmsálá	126·55	Himalayan tract.
Kángra	70·39	
Simla	69·99	
Siálkot	37·68	
Gurdaspur	31·86	Submontane zone.
Hoshiárpur	35·87	
Umballa	36·71	
Karnál	29·63	
Delhi	26·86	Jumna Valley.
Gurgaon	27·19	
Rohtak	20·31	
Hissar	16·44	East-southern border.
Sirsa	14·94	
Ferozepore	22·74	
Lahore	21·74	North-central districts.
Amritsar	26·61	
Gujránwála	25·58	
Jhang	11·36	
Montgomery	10·40	
Mooltan	7·26	Western Plains.
Muzaffargarh	5·96	
Dera Ghází Khan ...	7·31	
Dera Ismail Khan ...	9·12	
Abbottabad	44·93	
Murree	54·52	
Ráwalpindi	33·15	
Jhelum	24·38	Salt Range tract.
Kohát	19·66	
Pesháwar	14·27	
Bannu	13·19	

The rainfall is necessarily heavier in the Himalayas than in any other portion of the Province, the vapour-laden air from the south-east and south precipitating its water as it rises to top the great barrier which it finds across its path. The highest average of the Province is the 126·5 inches enjoyed by Dharmsála, and the figures probably nowhere fall below 50 inches within the Punjab Himalayas. Excepting the alpine regions, the rainfall is greatest in the east of the Province, as the Bombay monsoon is exhausted of its vapour in its passage over the great plains of Sind and Rájpútána, while the west winds from Bilúchistán and Afghánistán pass over an arid tract and leave such moisture as they may have collected on the western slopes of the Sulemáns, so that the Punjab depends for its rain very largely upon the south-east winds from the Bay of Bengal.

Chapter I.

The Province.

Rainfall.

Thus we find that in the plain country the rainfall decreases rapidly as the distance from the hills increases, and markedly also, though less rapidly, the further we go west. The submontane zone, presently to be described, which skirts the foot of the mountains, enjoys an annual fall ranging from 30 to 40 inches, while in the strip of country lying along the right bank of the Jumna the average lies between 25 and 30 inches. But in no other portion of the Province except in the portions of the Salt Range tract immediately under the hills are these figures approached. In the Eastern Plains the annual fall may be said, roughly speaking, to decrease by about one inch for every 10 miles of distance from the hills, and ranges along their southern border between 20 inches in the east (Rohtak) and 15 in the west (Sirsa). But directly we cross the meridian of Lahore and enter the great steppes of the Western Plains the figures fall to some 8 or 10 inches, while in the neighbourhood of Mooltan, in the extreme south-west of the Province, the yearly average is only 5 to 6 inches. The great rivers have a slight local effect in increasing the amount of precipitation in their immediate neighbourhood; and this influence is of more importance than would appear from the bare statistics, as the addition thus made to the total annual fall is distributed in the form of more or less periodical showers which often bring timely moisture to the crops.

Temperature and Climate.

Owing to its geographical position, to its scanty rainfall and cloudless skies, and perhaps to the wide expanse of untilled plains, the climate of the Punjab presents greater extremes of both heat and cold than does that of any other part of India. The extreme heat of the summer months begins to moderate about the middle of September; and from the beginning of October, though the days are still hot, the nights are fairly cool. From that time the temperature sinks lower and lower, till the minimum is reached with the fall of the winter rains in the early part of January, when sharp frosts are common, and water exposed at night with due precautions is frozen in all parts of the Province. The temperature then rises again slowly but steadily till the end of March. With April the hot weather proper may be said to begin. For the next three months the Punjab acts as the exhaust-chamber of India, and creates that monsoon of which it enjoys so small a share. The great plains bake throughout the long summer days, the heated air rises, and with it the barometer, the wind rushes in from the area of greatest pressure to the west and south-west to supply the partial void, and dust-laden hot winds sweep with unbroken violence over the open plains, while the dancing air seems to blaze with the glare reflected from the ground. It is said that the fierceness of this heat has a beneficial effect in disintegrating and preparing for tillage the surface of the fallow fields, similar to that exercised by frost in more frigid climates. Towards the end of June the wind changes—at least in the east of the Province; the vapour-laden monsoon travelling up the Ganges Valley approaches our border; the sky grows heavy with clouds, and the heat becomes stifling, almost beyond endurance, till the first burst of the welcome rains relieves the tension. The succeeding three months constitute the

rainy season; the heat of July is hardly less intense than that of June, but the air is moist, while from the middle of August the temperature gradually falls, and it again becomes possible to believe in the existence of winter.

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The Province.

Temperature and Climate.

Within the hills the seasons and their changes are very similar, though of course the heat is much more moderate and the cold much more severe. From the middle of December to the middle of January snow-storms are heavy and frequent throughout the Himalayas proper; while even in the height of summer the thermometer seldom rises above 90° in the shade.

The following figures show some details of temperature for the last five years:—

Stations.	Temperature in the shade (Degrees Fahrenheit).									
	Maximum in May.					*Minimum in December.*				
	1878.	1879.	1880.	1881.	1882.	1878.	1879.	1880.	1881.	1882.
Delhi	104·9	116·4	113·3	114·1	116·0	38·3	41·3	60·0	42·6	46·4
Sirsa	107·4	117·5	114·4	115·9	117·2	29 9	33·0	57·4	34·0	36·7
Ludhiána	104·8	113·8	110·8	118·3	114·6	32·0	24·0	55·6	38·0	37·0
Lahore	103 8	120·3	114·5	116·3	116·5	29·8	34·8	56·6	38·0	39 5
Mooltan	110·9	115·9	114·9	112·9	113 5	30·0	33·0	59·9	36 0	38 0
Dera Ismail Khan ..	104·5	118·5	114·5	115·5	118 5	26·0	32·0	56 2	35·0	32·0
Pesháwar	98 5	111·5	111·5	112·3	112 5	25·7	29·2	52·4	32·7	33·2
Ráwalpindi ...	95·5	114·0	109·0	114·0	114·0	23·9	26·9	51·6	60·0	31·9
Murree	79·1	92·4	87·7	89 0	91 5	33·1	28·7	44 7	34·5	35 5
Simla	...	94·4	86·4	83·3	86 4	...	34 6	44 3	37·6	38·4

Natural Divisions of the Province.

Thus the Punjab may be divided, in accordance with its physical features, into four great natural divisions, each of which is briefly noticed below. The Himalayan region and the corner cut off by the Salt Range are special tracts distinct in all their characteristics from the plain country of the Province. This last, excluding the submontane zone, which connects it with the hill regions to its north, is divided by a meridian passing through Lahore into two very dissimilar tracts which may be called respectively the Eastern and the Western Plains; and one of the most striking features of the Province is the strong contrast which these two tracts present, whether from a physiographical or from an ethnographical point of view, and the comparative suddenness with which the transition takes place as the intangible line which separates the one from the other is crossed. Physically, the Eastern Plains are arable plains of moderate rainfall and almost without rivers, save along their northern and eastern edges; while the Western Plains consist of arid pastures with scanty rainfall traversed by five great rivers, of which the broad valleys alone are culturable.* Ethnographically, the distinction between the people of the two tracts is in a large measure that between the Hindu inhabitants of India and the

Chapter I.
The Province.
Natural Divisions of the Province.

Mussalmán peoples of the trans-Sulemán country. But the difference is not merely, or even chiefly, one of religion. The tribal organization, the structure of society, the customs of daily life, and even the tenures of land, present a very marked contrast in the two tracts; and perhaps the distinctions may be best summed up by saying that to the east the caste, and to the west the tribe, is the social unit. How very distinct the social connotations of the respective words are is shown in the Report on the Punjab Census of 1881. Within the hills and in the submontane zone which skirts them the same distinction is to be found. But the line which separates the eastern from the western type lies much further to the west than in the plains, and may be said roughly to pass through the point where the Salt Range leaves the Himalayas. The several tracts thus indicated will now be separately discussed.

The Himalayan Tract.

Within the great net-work of mountain ranges which fringe the central system of the Himalayas are situated the States of Chamba, Mandi and Suket, together with Náhan, Bashahr, and the eighteen smaller States which are under the charge of the Superintendent of Hill States at Simla, the hill station of Simla, and the great Kángra District, the last including the Kullu Valley, which stretches up to the Mid-Himalayas, and the cantons of Láhul and Spiti, which, situated beyond the Mid-Himalayas, belong geographically to Ladakh and Tibet rather than to India. This mountainous tract includes an area of some 19,840 square miles, much of which is wholly uninhabited, and a scanty population of about 1,539,000 souls living scattered about the remaining area in tiny hamlets perched on the hill-sides or nestling in the valleys, each surrounded by its small patches of terraced cultivation, irrigated from the streams which run down every gulley, or fertilised by the abundant rainfall of the hills.

The people chiefly consist of hill Rájpúts, including Thakars, Ráthís, and Ráwats, and of Kanets, Ghiraths, Bráhmans, and the Dágís or menials of the hills. But it is probable that only the very highest classes among the Bráhmans and Rájpúts have preserved the purity of their blood; it is certain that the Aryan and aboriginal stocks have mingled with unusual freedom; and all between the very highest and the very lowest form a practically continuous gradation within which it is difficult to draw any definite lines of demarcation. The hill people are, whether by origin or by long isolation from their neighbours of the plains, very distinct from the latter in most respects, and they speak dialects peculiar to the hills though belonging to the Hindu group, except in the trans-Himalayan cantons, where Tibetan is spoken. They are almost exclusively Hindus, but curiously strict as regards some, and lax as regards others, of the ordinances of their religion. The nature of the country prevents the growth of large towns; trade is confined to the little that crosses the high passes which lead into Tibet; and the people are almost wholly rural, supplementing the yield of their fields by the produce of numerous flocks of sheep and goats, and by rude home manufactures with which they occupy themselves during the long winter evenings. They keep very much to them-

selves, migration being almost confined to the neighbouring mountains and low hills.

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The Submontane Tract.

Skirting the base of the hills, and including the low outlying range of the Siwáliks, runs the narrow submontane zone, with an average breadth of some 25 to 30 miles measured from the foot of the Himalayas proper. This tract, secure in an ample rainfall, and traversed by streams from the neighbouring hills, has an area of some 6,680 square miles, comprises some of the most fertile and thickly-peopled portions of the Province, and is inhabited by a population of about 2,998,000 souls, who occupy an intermediate position in regard of race, religion, and language between the peoples of the hills and of the plains, Muhammadanism being less prevalent, Hindi more generally spoken, and Rájpúts and hill menials more numerous than among the latter. The Gújars form a special feature of this zone. The tract has only one town, Siálkot, of more than 22,000 inhabitants; its trade and manufactures are insignificant, and its population is almost entirely agricultural, and in the low hills pastoral.

The Eastern Plains.

Turning to the plain portions of the Punjab, we find that east of Lahore the rainfall is everywhere so far sufficient that cultivation is possible without irrigation in fairly favorable seasons; but over the greater portion of the area the margin is so slight that, save where the crops are protected by artificial irrigation, any material reduction in the supply entails distress, if not actual famine; and while the Eastern Plains, comprising only a quarter of the area of the Province, include half its cultivation, nearly half its population, and almost all its most fertile portions, they also include all those parts which, by very virtue of the possibility of unirrigated cultivation, are peculiarly liable to disastrous failure of crops.

The Eastern Plains may be roughly divided into four separate regions. A broad strip parallel to the submontane zone partakes in a lower degree of its ample rainfall. It is traversed by the Upper Sutlej, the Beas, the Ravi, the Bári Doáb Canal, and many smaller streams, which bring down with them and deposit fertilizing loam from the lower hills; irrigation from wells is everywhere easy; and the tract is but little inferior in fertility, security of produce and populousness to the submontane zone itself. Its width varies from 20 to 30 miles; its area is some 8,600 square miles; and its population about 4,035,000.

The next most fertile strip is that running along the eastern border of the Province, parallel to the River Jumna. It enjoys a fair average rainfall; it includes the low riverain tract along the Jumna itself where well-irrigation is easy; the Saraswati and its tributaries inundate a considerable area, and much of it is watered by the Agra and Western Jumna Canals, so that it is for the most part well protected against famine. It has an average breadth of some 35 or 40 miles; its area is about 4,870 square miles; and its population some 1,848,000 souls.

Along the southern border of the tract run the districts of Hariána and Bhattiána, and constitute the most unfertile portion of the tract. A large part of it skirts the great Rájpútána desert; the soil is often inferior; the rainfall always scanty and precarious;

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The Eastern Plains.

while, except in the south-eastern corner, where alone wells can be profitably worked, irrigation is almost unknown, save where the Western Jumna Canal enters Hissar and the Sutlej borders the Sirsa District.* Its width is from 40 to 50 miles, its area about 11,570 square miles, and its population about 1,665,000. This and the central portion, next to be described, together constitute the great area of closed drainage already mentioned, and are the parts of the Punjab where famine is most to be dreaded.†

The remaining or great central portion of the tract includes the larger part of the great Sikh States. Its area is some 9,980 square miles, and its population about 2,810,000. It occupies an intermediate position in respect of fertility between the two preceding tracts, the rainfall generally being highest and the soil best to the east, west and north, in the direction of the Jumna, the Sutlej, and the hills, and lowest and worst in the centre and south; while to the north-east the Ghaggar system of hill streams inundates a certain area, and well-irrigation is practised along the Sutlej and the northern border.

The Eastern Plains include all the most fertile, wealthy and populous portions of the Province, and may be called the granary of the Punjab. Within them lie the three great cities of Delhi, Amritsar and Lahore, besides a very large proportion of the larger towns; and the population is, by comparison with that of the Western Punjab, largely urban. Trade and manufactures flourish, while, with the exception of the south-westward portions, where flocks and herds pasture in extensive jungles, the greater part of the culturable area is under the plough.

Ethnography of the Eastern Plains.

The plains east of Lahore have thus been split up into zones of varying fertility by lines running for the most parallel to the hills. But the boundaries which separate religion, race and language are somewhat different from these. A meridian through the town of Sirhind, nearly due north of Patiála, roughly divides, as the name of the town implies (*Sar* head, and *Hind* Hindústán), the Punjab proper from Hindústán, and the Punjabi from the Hindi language, and forms the eastern boundary of the Sikh religion. So much of the Punjab plains as lies east of that line differs little, if at all, in the character of its population from the western districts of the North-Western Provinces. Excepting in the Rohtak District, Jats form a smaller and Rájpúts a larger proportion of the population than in the tract immediately to the west; while the minor land-owning tribes consist chiefly of Kambohs, Rors and Gújars in Umballa and Karnál; Tagas in Karnál and Delhi; Ahírs in Rohtak, Delhi and Gurgaon; and Meos and Khánzádahs in Gurgaon.

The Hissar District to the south of the tract differs from the districts just mentioned, chiefly in that, lying as it does on the confines of Bikanír, the dialect and people are more akin to those of Rájpútána than to those of Hindústán, Rájpúts being very numerous, and there being a considerable Ahír population. The

* A certain area is also inundated by the precarious floods of the Lower Ghaggar.
† But the Sirhind Canal, which has just been opened, will protect a large part of the central, and some portion of the southern, tract.

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Ethnography of the Eastern Plains.

religion is still Hindu, with a certain admixture of a curious sect called Bishnoi. The Sirsa District, which lies along the western portion of the southern border of the tract, was all but uninhabited till it came under English rule; and it has drawn its settlers pretty equally from Hindu and Hindi-speaking Hissar and Rájpútána, and from the Sikh and Punjabi-speaking Jat State of Patiála, while its western portion is occupied by Muhammadan immigrants from the Lower Sutlej.

In all the remainder of the tract Punjabi is the language of the people. Immediately below the hills Sikhism has obtained but little hold, and the Hindu element, strong in Hoshiárpur, gradually gives way to the Mussulmán as we pass westwards through Gurdáspur, till it fades into comparative insignificance in Siálkot. But all the centre of the tract, the great Phulkián States and the north-central districts form the very stronghold of the Punjab Sikhs. Even here, however, a very large proportion of the population is Mussulmán—a proportion constantly increasing from east to west; and it is the Hindu element alone which is displaced by the Sikh. In the matter of race the population of this portion of the tract is very uniform, Rájpúts, Jats and their allied tribes forming the staple of the agricultural population, largely supplemented by their attendant menials. In the direction of the hills Jats are fewer, and Rájpúts and Gújars more numerous; while somewhat further south the proportion of Jats increases. and the market-gardening castes, together with the Mahtams and Dogars of the Sutlej, become important elements. In the Lahore Division and the great Sikh States the mass of the population is Jat, though in the east Ahírs and in the west Kambohs, Mahtams and Dogars hold large areas.

The Changars and Sánsís of Amritsar and the surrounding districts, the Baurias of the Middle Sutlej, the Ráwals of the northern districts and Lahore, and the Aherís of the Hissar Division, are curious outcaste tribes, some of them probably aboriginal; and as we pass westwards and northwards from Hindústán and Rájpútána into the Province, the Banya of the Delhi territory gives place to the Khatri of the Central, the Súd of the Northern, and the Arora of the Western, Punjab.

The Western Plains.

The great plains lying to the west of the Lahore meridian present a striking contrast with those to the east of that line. They form the common terminus of the two Indian monsoons, which have exhausted themselves of their vapour before they reach their goal; and the rainfall, heaviest in the north and east, and decreasing towards the west and south, is everywhere so scanty that cultivation without irrigation is absolutely impossible. But in this very circumstance they find their security against famine or distress from drought, for their cultivation is almost independent of rain, a failure of which means nothing worse than a scarcity of grass, in itself a sufficiently serious calamity. Rain is, of course, needed here as elsewhere; but its absence means only a diminished yield, and not, as in the Eastern Plains, no yield at all; and so little is sufficient if the fall comes at the right time, and absolute drought occurs so seldom, that the crops may be said never to fail from this cause. Indeed, more danger is to be anticipated from excessive flood than from deficient

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The Western Plains.

rainfall. The tract is traversed throughout its length by five great rivers—the Sutlej, Ravi, Chenab, Jhelum and Indus; and along either side of each of these runs, at a distance of a few miles, a more or less distinctly marked bank which defines the excursions of the river within recent times as it has shifted from side to side in its course. These banks include between them strips of low-lying land which are periodically inundated by the rising floods as the winter snows of the Himalayas melt under the summer sun, or in which the nearness of sub-soil water makes well-irrigation easy. All outside these narrow boundaries is a high arid plain. Beyond the Indus, and between the Sutlej and the Jhelum and its continuation in the Chenab, it consists of soil which, wherever water is available, is sufficiently fertile, save where, north of the Sutlej, saline efflorescence clothes the surface for miles together like a recent fall of snow. But between the Indus and the Jhelum-Chenab, and south of the Sutlej, it is covered by great parallel lines of rolling sand, separated by narrow hollows in which the original soil is exposed.

Numerous streams, for the most part of intermittent flow, which run down from the Sulemán Mountains to join the Indus, and innumerable small inundation-canals carried out from the Sutlej, the Lower Chenab, the Upper Jhelum and the Lower Indus, across the zone of well irrigation into the edges of the central steppes, render cultivation possible along their courses; while wells sunk in the long hollows of the *thal* or sandy desert, and the drainage of the *bár*, or stiff loam uplands, collected in local depressions, perform a similar office. But though some of the finest wheat in the world is grown on the wells of the western *thal*, the proportion of the area thus brought under the plough is wholly insignificant. The remainder of the tract is covered by low, stunted bush and salsolaceous plants, and with short grass in good seasons. Over this range great herds of camels, which thrive on the saline herbage, and of cattle, sheep and goats. They are tended by a nomad population which moves with its flocks from place to place as the grass is consumed, and the scanty supply of water afforded by the local hollows exhausted, or in search of that change of diet which camels love and the varying local floras afford. The area of the tract is some 60,870 square miles, or more than two-fifths of that of the whole Province; while its population, numbering about 4,885,000 souls, includes little more than one-fifth of the people of the Punjab, and it comprises not one-quarter of the total cultivated area. Mooltan is the only town of more than 23,000 inhabitants; and the population is very markedly rural. There is no manufacture of importance, and the great *powindah* traffic between India and the countries to the west only passes through the tract on its way to the commercial centres of Hindústán. Pastoral pursuits occupy a more important position than in the rest of the Punjab, agricultural produce being largely supplemented by clarified butter, wool, hides and barilla.

Natural Divisions of the Western Plains.

It is the fashion to describe the Punjab proper as marked off by its rivers into six great *doábs*, which constitute the natural divisions of the Province. This description is true in a sense, but the sense in which it is true possesses but little significance, and its chief

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Natural Divisions of the Western Plains.

merit seems to be that it can easily be verified by reference to a map. To the east of the Lahore meridian such rivers as there are lie close together within the submontane tract, the whole of the country between and the area of closed drainage beyond them is comparatively populous, and there are no natural boundaries of any great importance. But west of that meridian, or throughout the greater portion of the Punjab proper, the real obstacles to inter-communication, the real barriers which separate the peoples one from another, are not the rivers, easily crossed at any time and often fordable in the cold weather, but the great arid steppes which lie between those rivers. The advance of the agricultural tribes has followed almost invariably the courses of the great rivers, the newcomers having crept along both banks of the streams and driven the nomads from either side into the intermediate *doábs*, where they have occupied the portions nearest the river lands from which they had been ejected, leaving the median area of greatest aridity as an indefinite but very effectual line of separation.

Ethnography of the Western Plains.

Between the Sulemáns and the great sandy deserts of Baháwalpur and the Sind Ságar *Doáb** the dominant race is Bilúch, save in the northern parts of Dera Ismail Khan District, where Patháns take their place. Both these races have descended from the hills and overcome a miscellaneous collection of tribes which, still forming a very large proportion of the population, have been included by their conquerors under the semi-contemptuous term of Jat—here an occupational as much as an ethnological designation—till they have themselves almost forgotten their original races. In the remainder of the tract the divisions of the people are rather tribal than racial, the great majority of them having travelled up the river valleys into the Punjab, and either being Jats and Rájpúts, or belonging to races, perhaps in some cases of aboriginal origin, which can now no longer be distinguished from them. In Gujrát the importance of the Gújar element is indicated by the name of the district; while Sayads are numerous to the south-west. The number of clans into which the people of these great plains are divided is enormous. The Daudpútra, Joya, Wattu, Dogar and Mahtam of the Sutlej, the Kharral and Khátía of the Ravi, the Siál and Khokhar of the Chenab, and the Khokhar and Tiwána of the Jhelum, are some of the most important. The curious fishing tribes of the Sutlej and Indus, the Jhabel, Kehal, Mor, and the like, present many features of interest. The trans-Indus Patháns and a certain proportion of the Bilúchís speak their natural Pashtu and Bilúchi. The remaining population of the Dera Ghází Khan, Muzaffargarh and Mooltan districts and the Baháwalpur State speak Jatki, a language holding an intermediate position between Punjabi and Sindi. Punjabi is the speech of the remainder of the tract. The population is essentially Mussalmán, the proportion being largest on the frontier, and smallest to the east and south.

The Salt Range Tract.

There still remains to be described the north-western corner of the Punjab, situated in the angle where the Sufed Koh from the west and the Sulemáns from the south meet the Himálayas from

* The Sind Ságar *Doáb* lies between the Indus and the Jhelum and Chenab.

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—
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The Salt Range Tract.

the east, and separated from the rest of the Province by the Salt Range and the Upper Jhelum. It includes the Peshâwar Division and the districts of Ráwalpindi, Jhelum and Bannu. It presents in almost every respect the strongest possible contrast with the Punjab proper, and, indeed, as already remarked, can hardly be said to belong to India, save by mere geographical position. The physical configuration, which has already been described at page 5 is so broken and confused that it is impossible without going into great detail to separate it into parts, each of which shall be even approximately homogeneous. The mountainous tracts of Hazára and of the Murree and Kahúta *táhsíls* of the Ráwalpindi District, with their ample rainfall, and of the less favored district of Kohát, cover an area of 6,520 square miles, and contain a population of some 715,000 souls. The remainder of the tract has an area of about 14,500 square miles, and a population of some 2,209,000 souls. Except immediately under the hills, the rainfall, while quite sufficient in ordinary years, leaves little margin as protection against distress in unfavorable seasons; while, save in Peshâwar and the riverain portions of Bannu, irrigation is almost unknown. With the exception of Peshâwar and Ráwalpindi, the tract includes no town of more than 20,000 inhabitants. But the whole trade with Central Asia and Kabul, except the *powindah* traffic of Dera Ismail Khan, passes through Peshâwar; and the Salt Range supplies almost the whole of the salt used in the Punjab. The silk and cotton fabrics of Peshâwar are the only manufactures of importance; and the mass of the population follows agricultural and in the mountain ranges pastoral pursuits.

Ethnography of the Salt Range Tract.

The population of the whole tract is almost entirely Mussalmán, the very traders being Muhammadans in Peshâwar. The language is Pashtu in the trans-Indus, and dialects of Punjabi in the cis-Indus portions of the tract. The population has apparently entered the tract either from the Upper Sulemán and Eastern Sufed Koh, or from the hills of Kashmir, the proportion which has passed in by the river valleys being probably small. The people are chiefly Patháns in Peshâwar and Kohát, with a large admixture of menial classes of Hindu ancestry, who, though now Mussalmáns, are known under the generic name of Hindki. In Bannu the mass of the people consist of Patháns and the so-called Jats described above. The term Jat is little used beyond the Salt Range. In Hazára the Pathán villages are few, and confined to the bank of the Indus; but the centre and north of the tract are occupied by curious tribes, probably of Indian origin, but now by long association closely assimilated to the Afghán race, the principal of which are known as Jadún, Swáti and Tanáoli, and by Sayads. In the south and south-west of Hazára, and in the hills of Murree and Kahúta, are found the Kahúts, Dhúnds, Sattís and Ketwáls, all claiming to be hill Rájpúts, together with Awáns, Kharráls, Gakkhars, and numerous Gújars. The Salt Range is largely in the possession of a tribe of mysterious origin called Awán, which has wrested the greater part of it from its original holders, the Janjúa Rájpúts, and spread northwards towards the hills, and east and west across the Jhelum and Indus, though, like all other non-

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Patháns, merged in the comprehensive name of Jat as soon as the range crosses the latter. In the less hilly portions of Ráwalpindi and Jhelum, Rájpúts, or tribes which claim Rájpút origin, with Awáns, Gakkhars, Khattars, and a few Gújars, constitute the greater part of the population. Sayads are numerous throughout the tract. In the city of Peshávar itself is to be found a most extraordinarily cosmopolitan population, including representatives of almost every Muhammadan country east of Arabia.

Summary of the above with leading Statistics.

It will be convenient here to collect some figures regarding the tracts just described and to summarise their salient characters. The statistics given in columns 6 to 11 of the following statement are only approximate. Further details will be found in the Statistical Tables attached to this volume.

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Summary of the above with leading Statistics.

Leading Statistics for the Natural Divisions of the Province.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					APPROXIMATE FIGURES.									
					Rainfall in Inches.			Percentages of Area for each Tract.			Percentages of Area and Population of Province contained in each Tract.			
Serial No. of Tract.	Name of Tract.	Area in square miles.	Total population.	Population per square mile.	Highest.	Average.	Lowest.	Cultivated on total.	Culturable on total.	Dry on cultivated.	Total area.	Population.	Cultivated area.	Culturable area.
I	Himalayan Tract	19,840	1,539,000	78	126	80	40	10	14	82	14·0	6·8	4·3	3·2
II	Submontane Tract	6,680	2,998,000	449	54	37	30	64	71	78	4·7	13·2	9·6	5·4
	Eastern Plains—													
III	Northern Zone	8,600	4,035,000	469	35	27	23	73	87	67	6·1	17·8	13·9	8·6
IV	Eastern or Jumna Zone ...	4,870	1,848,000	379	34	28	19	71	83	55	3·4	8·1	7·8	4·6
V	Central Block	9,980	2,810,000	282	27	19	17	57	89	42	7·0	12·4	12·6	10·2
VI	Southern or Bhattiána Zone ...	11,570	1,665,000	144	20	16	13	55	92	80	8·1	7·3	14·2	12·1
	Total Eastern Plains ...	35,020	10,358,000	296	35	21	13	62	89	62	24·6	45·6	48·5	35·5
VII	Western Plains ...	59,890	4,885,000	82	20	6	1	18	67	6	42·0	21·5	24·1	45·7
	Salt Range Tract—													
VIII	Mountain Tract	6,520	715,000	110	62	41	20	15	24	73	4·6	3·2	2·2	1·8
IX	Table-lands	14,500	2,209,000	152	32	17	10	35	51	85	10·1	9·7	11·3	8·4
	Total Salt Range Tract ...	21,020	2,924,000	139	62	24	10	29	42	83	14·7	12·9	13·5	10·2
	Total Punjab	142,450	22,704,000	159	126	24	1	31	61	60	100·0	100·0	100·0	100·0
	Troops of the Khaibar Pass ...	...	8,000	...	...	...	...	...	...	...	...	...	...	...

NOTES TO STATEMENT.

Tract I—Himalayan.—The mountain tract of Kángra and the Hill States; with large rainfall and irrigation from hill streams. Cultivation scattered and inferior. Population of rustic Hindu hillmen, chiefly Rájpúts and allied races, living in tiny hamlets; agricultural and pastoral. Language—Hill dialects of Hindi. No large towns; trade and manufactures insignificant. Secure from famine.

Chapter I.

The Province.

Summary of the above with leading Statistics.

TRACT II—SUBMONTANE—Zone along the foot of the Himalayas. Ample rainfall and fertile soil. Large rural and agricultural population, and no large towns. Secure from famine.

TRACT III—EASTERN PLAINS (NORTHERN).—Zone parallel to and south of Tract II. Considerable rainfall and fertilizing hill streams. Soil fruitful and well-irrigation ample. Very populous and several large towns. Almost secure from famine.

TRACT IV—EASTERN PLAINS (EASTERN).—Zone along the Jumna. Rainfall fair, irrigated area large, and soil fertile. Large population and several large towns. For the most part in but little danger from famine.

TRACT V—EASTERN PLAINS (CENTRAL).—Occupying the centre of the Eastern Plains. Soil and rainfall fairly good, and irrigation possible to north, east and west; inferior and impossible in south. Population of average density; agricultural; and in the south pastoral. Several large towns; liable to famine.

TRACT VI—EASTERN PLAINS (SOUTHERN).—Bordering Bikanír desert. Rainfall deficient; soil inferior; irrigation impossible. Scanty agricultural and pastoral population. Few large towns; very liable to famine.

EASTERN PLAINS—TRACTS III, IV, V, VI.—Population chiefly Jats, Rájpúts and allied races with menials. Religion—Hindu in north, east and south; Mussalmán in north-west and south-west; Sikh in centre and to west. Language—Hindi to east and south-east, Rájpútána dialects to south-west, Punjabi in the remainder. Includes all the largest towns; and trade and manufactures flourish.

TRACT VII—WESTERN PLAINS—Comprises the mass of the Western Punjab. Rainfall wholly inadequate. Cultivation chiefly confined to the immediate precincts of the rivers. Between them great grazing-grounds; in parts covered with sand, and occasionally saline. Population scanty, largely pastoral, and partly nomad. Patháns and Bilúchís on the frontier; elsewhere Jat, Rájpút and allied tribes. Religion—Mussalmán. Language—Pashtu and Bilúchí across the Indus, Jatki to south-west, elsewhere Punjabi. Few large towns; little trade or manufacture. No famine possible beyond distress from failure of grass.

TRACT VIII—SALT RANGE (MOUNTAINS).—Mountains of Hazára and Kohát, and the east of Ráwalpindi. Rainfall ample; cultivation inferior. Scanty agricultural and pastoral population of Patháns and curious allied races, Hill Rájpúts, Awáns and Gújars. Religion—Mussalmán. Language—Pashtu in Kohát, Punjabi dialects in Hazára. No large towns. For the most part secure from famine.

TRACT IX—SALT RANGE (TABLE-LAND).—Pesháwar Valley. Salt Range, and table-lands of Bannu, Ráwalpindi and Jhelum. Rainfall somewhat scanty. Irrigation hardly practised. Somewhat thinly peopled by Patháns on the west, Awáns to the south, and Rájpúts and Gakkhars in the remainder. Language—Cis-Indus, Punjabi, Trans-Indus Pashtu. Religion—Mussalmán. Few large towns. Trade and salt-mining extensive. Liable to famine.

CHAPTER II.

GEOLOGY.

NOTE.—*The following Sketch of the Geology of the Punjab was kindly prepared by Mr. H. B. Medlicott, then Director of the Geological Survey of India, for insertion in this Gazetteer. Unforeseen circumstances delayed the publication of the Provincial Volume of the work; but the Sketch as it now stands was in the hands of the Editor in November,* 1883. *It is available in the form of a separate pamphlet.*

SECTION A.—INTRODUCTORY.

Chapter II, A.

Introductory.

Geography dependent on geology.

Geological agencies being so slow in operation when compared with the life or the history of man, it is no wonder that the configuration of the earth's surface or of separate countries has been treated as a fixture, and described from that point of view as geography. This is of course unavoidable when mere portraiture is concerned, as in maps, but it is no longer fitting that in the verbal description of the varied features of the ground surface no mention should be made of their mode of formation and history. Rational geography must therefore introduce geological considerations. Geography, in fact, apart from mere topography, becomes a corollary to geology.

Postulates of geology.

There need be no objection to this suggestion on the score of difficulty; for, the initial postulates of geology being based upon facts of universal experience, the statements involved in such geographical descriptions must be perfectly intelligible to any one, even though at first sight the credibility of them may be questioned. These postulates can be enunciated in the briefest form: geologists affirm that stratified rocks were formed as we now see deposits accumulating by the action of water; while volcanoes (active or extinct) offer an equally safe standard of identification for all the remaining forms of rock; also, that the inequalities of the earth's surface were primarily formed by actual upheavals and depressions, whether in broad areas with little fracture of the rocks, or concentrated along certain lines with intense contortion of the strata. "True mountains" belong to this latter kind of disturbance. Actual cases of local upheavals and depressions have been witnessed and measured. Finally, the sculpturing of the raised areas is visibly the result of wear and tear by atmospheric waters.

Main geological regions of India.

The agreement implied by the foregoing statements between geographical and geological features is very decided in the demarcation of main regions; while it becomes rapidly less so as we go into geological details. For instance, a mountain mass composed of very similar rocks may comprise several distinct formations, but this fact has no significance in the geographical feature; of this there will be abundant examples in the sequel; we have to begin

Chapter II, A.

Introductory.

with the leading features of agreement. India has been separated as regards its rock surface into two great divisions, the peninsular and the extra-peninsular; the great intervening plains forming a third region of comparatively insignificant importance in geological history. The Punjab holds ground in all three divisions.

The Punjab Plains.

A very large proportion of the Punjab lies within the Indo-Gangetic plains, which continue south-westwards through Sind to the Arabian Sea, and south-eastwards through the North-West Provinces, Behar, and Bengal to the Bay of Bengal. In the broad angle thus formed the plains rise gently southwards, through Rájpútána, to the flanks of the Aravali hills which form the north-western region of the peninsular rock area, some small outliers occurring within the Punjab in Delhi and Hissar. Northwards, the plains rise to what may be called their outer margin, where the extra-peninsular rocks rise abruptly into steep and high hills, very rarely having any stragglers within the alluvial area.

The Punjab Mountains.

The peninsular and extra-peninsular regions so well defined by the intervening plains are also distinguished by marked characters peculiar to each area. The peninsula is a great block of land which has through a long lapse of ages undergone only very partial and local disturbance, and all its later sedimentary rocks, including some of high antiquity, are distinctively freshwater or subærial deposits; whereas the extra-peninsular rocks, except the later tertiaries, are marine deposits, and even the newest tertiary beds have everywhere undergone extensive disturbance along regular lines of upheaval. Thus in its present general outlines the whole of the latter region belongs approximately to one and the same age, and is markedly newer than the former. This distinction is clearly betrayed in the fact, already indicated, that the plains' deposits have spread amongst and isolated the worn-down remnants of the Aravali rocks, while they stop short against the continuous lines of upheaval of the extra-peninsular area.

The extra-peninsular mountain region of the Punjab.

With respect to the extra-peninsular area, the Punjab occupies a peculiar position—in the angle where the lines of mountain upheaval undergo complete and abrupt changes of direction. On the north-east the Himalayan axes with a north-westerly trend run very steadily up to the Jhelum; while on the west the axes of the Sulemán maintain a northerly direction up to the Kurram river. In the block between these two dominant systems we find ranges of devious trend in which an east-west course prevails, corresponding to that of the Sufed Koh in Afghánistán; of this group the Salt Range is the best known example.

The non-parallelism of its mountain ranges discussed.

Such total and sudden changes of direction in great lines of contortion, belonging more or less to the same period of disturbance, has been a point of some theoretical difficulty in view of certain hypotheses which would require synchronous disturbances to be in parallel directions. The question can best be noticed here, as it concerns each of the three main divisions of our ground. This feature of direction is nowhere so conspicuous as where its limits are defined along the edge of the great plains, and it seems most

Chapter II, B.

The Aravali Region.

The non-parallelism of its mountain ranges discussed.

probable that the explanation of the difficulty is to be found in the form of the more ancient land of the peninsular area. It is now generally understood that the crushing of strata resulting in the upheaval of mountains is due to tangential pressure in the earth's crust caused by the shrinkage of the interior, so that the unsupported weight is converted by the earth's curvature into horizontal thrust. This may find relief in several ways: by slight warping of the curvature, producing the elevation and depression of large areas; or by slight compacting of the rocks, with local disturbance at many places over a large area; but it is certain that it sometimes settles into great flexures of the strata where most susceptible to compression, and this implies a greater strength of resistance in the adjoining masses, the form of which would thus in a great measure determine the direction of the axes of contortion.

The peninsular rock-system extends beneath the Punjab plains.

The general parallelism of the northern edge of the peninsular area to the Himalayan border along the opposite side of the Gangetic plain gives considerable plausibility to this view, and it is probable that the gneissic rocks of the peninsula extend a long way northwards beneath the plains. The great north-western prolongation of the plains in the Punjab might seem to be more an independent result of the extra-peninsular disturbance, but the only direct evidence brings this feature too into the same relation with the older rock area: for on both sides of the Chenab, at Chiniot and Karána, only 40 miles from the Salt Range and about 200 miles from the nearest outcrops of the Aravali rocks, some small hills which rise from the plains are composed of quartzites and schists, quite unlike any rock found in the Salt Range or anywhere in the ground bordering the plains on that side, but of the same character as those forming the mass of the Aravali hills. There is confirmatory evidence in the Salt Range itself: everywhere else the newer tertiary rocks appear at the edge of the plains, but here there is a long section of very old formations turned up to view, and in composition and arrangement they suggest coastal conditions in this position. It thus seems presumable that the plains are for the most part underlaid by rocks of the peninsular area, or at least that such rocks as do occur are not deeply affected by the disturbance that has upheaved the extra-peninsular rocks.

The foregoing remarks will suffice for a general introduction to the ground. We may now give some particulars of the separate regions; and it will be convenient to dispose first of the most ancient ground, forming the Aravali region and extending into the Delhi and Hissar districts.

SECTION B.—THE ARAVALI REGION.

Limits of the Aravali Region.

The Arvali region is the most distinctly separable factor of the peninsular rock area. It is the remains of a very ancient mountain system having a north-east trend, and therefore tangential as it were to that area at its north-west extremity, its boundary here being very sharply defined by the scarp of the Vindhyan plateau

from Fatehpur Sikri (near Agra) to Chitor, and thence by the scarp of the Malwa trappean plateau to the Narbada. Its southern skirts are covered by newer rocks in Guzerat and Cutch. On the west and north, towards the Punjab, it can be said to have no boundary, presenting only straggling outliers of rock more or less encompassed by the alluvium of the rivers and the blown sands of the desert. We have seen reason to suppose that if these were removed, rocks of the Aravali region would be found to extend in the Punjab nearly up to the boundary of the extra-peninsular area. The low range of hills from which the name of the region is taken, and which is probably the remnant of the axis of the original system of upheaval, is chiefly developed between Palampur and Ajmer, beyond which place its continuity is very broken, the alluvium sweeping right through it at many points, as where the Sámbhar salt lake lies right in the run of the axis. The most northerly outliers on the line of the range occur near Hissar and Rohtak, touching the Jumna at Delhi. A notice of this region is therefore required in a sketch of the geology of the Punjab.

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The Aravali Region.

Limits of the Aravali Region.

The rocks forming the range itself belong, so far as is known, to two series to which the names Aravali and Delhi have been given. The former is the older of the two, and consists, within the range and for some width on either side, of crystalline schists in great variety, with crystalline limestone and some quartzite. In many parts the schists are largely associated with gneiss, and all are folded together in complicated contortions having the prevailing north-north-east strike of the range. Granitic intrusions occur extensively in and near the range; while at a distance from it the metamorphic action diminishes, and the Aravali series consists chiefly of slates more or less schistose, as for instance to the east of Deoli. The Delhi series is best exposed in the Beána and the Alwar hills, from which latter it extends up to Delhi. It is principally composed of quartzites, locally conglomeratic with some partings of schists, and locally with strong bands of contemporaneous basic trap. This series occurs also within the range, where the highest ridges are thought to be formed of Delhi (or Alwar) quartzite, and where it also is locally affected by the intrusive granite.

The Aravali and Delhi rock-systems.

It will be understood that stratified rocks may give evidence of two very different periods, that of their deposition or formation and that of their subsequent disturbance. In the latter sense both of these rock series belong to the Aravali system, and give the lower limit for its date. The two series are however very distinct, and are found at many places in totally unconformable contact; each is, moreover, identifiable with extra-Aravali peninsular rocks still unaffected by the Aravali disturbance, thus showing the limit of that disturbance and its relation in time to the rocks of the peninsular area generally. The Aravali series has been fairly identified, at least in part, with the rocks that had been previously described as the Gwalior series, to the east of the Vindhyan plateau. Here the upper Vindhyans rest upon a deeply-eroded surface of the Gwalior rocks; but these rest in original undisturbed superposition upon the gneiss of Bundelkhand. Again, the Delhi series has

Age of the Aravali system.

Lower limit.

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The Aravali Region.

Age of the Aravali system.

Lower limit.

been traced to the south-west through Tonk and west of Chítor, into connection with some sandstones south-west of Nímach (Neemuch), where they show very little disturbance and are overlaid with slight unconformity by lower Vindhyan strata. On the west in this locality these sandstones rest upon an older gneiss, presumably of about the same age as the Bundelkhand gneiss, and this mass seems to have protected the sandstones here from the compression and metamorphism of the Aravali system. These facts show clearly that the Aravali gneiss, crystalline schists, and granite, and the causes to which the metamorphism and upheaval were due, are all of later date than some of the unaltered rocks of the peninsular area.

The gneiss of the Aravali Region.

If we adhere to the geographical outline as above indicated for the Aravali region, the older gneiss that has just been mentioned south-west of Nímach as probably of the same age as the Bundelkhand rock would have to be introduced as a third rock series within this region. It is not yet settled whether some of the many other outcrops of gneiss may not belong to the older kind.

The Vindhyan system.

Yet a fourth rock series has to be mentioned as belonging to the peninsular area in the Aravali region; and this is the Vindhyan series. For a long distance on the south-east the edge of the Vindhyan plateau has been taken as the boundary of the Aravali region. That boundary is for the most part a faulted one, and the fracture has certainly occurred on the lines of the Aravali disturbance; although even here it can be shown that this was a secondary effect produced long after the contortion and upheaval of the Aravali rocks, for on the north-west side of the fault there are some Vindhyan outliers resting flatly upon the vertical Aravali schists. Over the broad area between this boundary and the axis of the range all further traces of the Vindhyan rocks have been removed; but on the west side, and within a short distance of the present axial range, rocks that can with much certainty be identified as upper Vindhyan cover a considerable area, to within a few miles of Jesalmir. The average base of the formation seems about level with the present surface of the plains, and at many places the Vindhyan sandstone is seen resting flatly upon the contorted gneiss and schists of the Aravali series. Thus, in the Vindhyans (which are at least of palæozoic age), we have an upper limit for the date of the Aravali upheaval; and we can say that it must have occurred at quite a remote time before the Vindhyan period, for the range had then already been denuded to something like its present dimensions.

Age of the Aravali system.

Upper limit.

Intrusion of the extra-peninsular system.

We have still to notice some other rocks that occur within the outside limits conjecturally assigned for the Aravali region as defined by non-participation in the great extra-peninsular upheavals. About Jesalmir and west of it there occur low ridges of jurassic and nummulitic rocks belonging to the extra-peninsular formations. From the comparatively little disturbance they exhibit, it is probable that they are overlapping extensions on the margin of the peninsular area, and that Aravali rocks occur at no great depth beneath them.

SECTION C.—THE PLAINS.

Chapter II, C.

The Plains.

Sources of the Punjab sands.

Blown sand occupies no inconsiderable place in the rock formations of the Punjab. The Province has a "Little Desert" of its own in the Sind Ságar Doáb; and large tracts elsewhere are in a similar condition. There is no sea here to keep up the supply for these wind-deposits; but other sources are not wanting in the ever-renewed sand banks of the subsided rivers, and in the boundless barren hill region to westwards where the "sand-blast" must operate extensively as a denuding agent, supplying dust to be swept on by the wind and deposited elsewhere. The geological influence of the wind as a rock-producer has been very little studied or taken into account, but the importance of it cannot be doubted. We may recommend it as an interesting line of research to residents in the Punjab. The investigation should be historical as well as dynamical, for it is surely presumable that the present state of things has come about well within the human period and to a great extent since the earliest historical times. It is not to be believed that plains of fertile ground traversed by copious streams and in a sub-tropical climate were left by nature unclothed with vegetation. In the remote hills on both sides forest still survives, simply because it is out of reach of the spoiler. The process of spoliation is familiar to any one who has travelled in the jungles of India. Want or the petty profit of the moment is all that is thought of, no matter what the waste; and one may see square miles of withered poles of magnificent forest trees that have been ringed for the few ounces of gum to be extracted from each. At least a few years ago it was so, before the Forest Department came to the rescue.

When steep ground is thus uncovered it becomes rapidly denuded of its soil, and the bare rock remains. On the level ground, when an undue proportion of it is taken up for cultivation, an immense area is left bare under the baking summer sun after the spring crops are cut, to become so deeply desiccated and heated that much atmospheric moisture is repelled and never reaches the ground. In this way the climate becomes gradually changed at an accelerating pace, for each step makes recovery more difficult, and thus large tracts of north-western India have become waste, and the struggle against outraged nature for the rest becomes continually harder.

Formation of the Punjab plains.

From the condition of the great rivers it is at once apparent that the plains are most recent deposits; and that they have been, and are being, formed by these very rivers. The Punjab lies altogether in the western basin of the Indo-Gangetic plains, its eastern boundary coinciding with the watershed between the very flat basins of the Indus and Ganges systems; and that boundary is the river Jumna. On any longitudinal section of the plains taken east and west between the Siwálik hills on the north and Delhi (where the Jumna touches Aravali rocks) the highest level is on the banks of the Jumna. Now, that a river should run on a watershed is proof positive that it has made the ground it flows upon. This is the normal condition of a depositing river, as most

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Formation of the Punjab plains.

familiarly known in deltaic regions. By periodical overflow the river gradually raises its banks and at the same time its bed, and so finally runs on a broad ridge of its own construction. If left to itself it will finally break into the lower ground on either side through some hitherto small channel of overflow, and so take up a new course. A noted example of this occurred early in this century in north-eastern India, when the Brahmaputra deserted its old bed through the Maimensingh district and adopted a new channel 60 miles to the west, the change originating near the point of the Garo hills. In the Punjab much evidence has been brought forward to prove that within historical times the Sutlej followed a very different course from its debouch at Rúpar.* No geologist will question that all the great Himalayan rivers must have undergone like changes within very recent geological times.

North and south slope of the Punjab plains.

In other features of configuration the plains correspond to the mode of formation suggested by the cross-section at the rivers. All the streams, big and little, issue from their more or less steep and confined channels in the hills variously charged with detritus in time of flood. As they can immediately expand in the open country their carrying power is rapidly reduced, and much of the heavier and coarser detritus becomes deposited at the edge of the plains, only the finer sediment being carried to a distance. In this way a surface is formed having at top a considerable slope (more than 50 feet in a mile), which diminishes rapidly at first and then very gradually towards the final point of discharge. This is the form of the surface of the plains of India from the foot of the hills to the sea, their slopes corresponding with those of the rivers; and in extent their distribution corresponds with that of the water-power issuing from the adjoining hills. In this respect the Himalayan rivers greatly preponderate, and have accordingly laid down the greater part of the plains to near the northern edge of the peninsular area. The level of the Jumna bank at the edge of the Siwáliks is about 1,060 feet. The lowest point of the summit level of the plains may be taken up on the Jumna bank at Delhi, where it is about 700 feet, and followed to the west-by-north into the Punjab a little south of Rohtak and of Hissar, being defined by the line where the spill from the Aravali meets that from the Himalayas, and the surface rising both to north and south. Between Hissar and Sirsa this 700 feet contour-line bifurcates, going to north-north-west along the Himalayan spill to south of Lahore, while the other branch curves to the south-west along the Aravali spill to the west of Bikanír.

Erosion of the present valleys of the Punjab rivers. The Bar and western plains.

Any observant traveller in Upper India would at once notice that the foregoing description of the plains is not at all points correct. It has been thus given from the geological point of view, and in order the better to indicate the immediately actual state of the surface. The facts that have been given regarding the outline are correct, and also the inferences to be drawn from them; but the Jumna and the other great rivers do not now, even in the most abnormal floods, rise to the level of those banks asserted to have been

* Calcutta Review, July, 1874.

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Erosion of the present valleys of the Punjab rivers.
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formed by their overflow. To account for this it might at first be suggested that modern floods are less than those of yore; but observation makes the very opposite suggestion, for it seems that, although more or less in the same position as when they gave form to the adjoining lands, the rivers have since then eroded broad valleys, to as much as 100 feet deep, in their former deposits, thus producing the characteristic features of the western plains of the Punjab. These valleys are known as *khádirs*, as distinguished from the *bángars* or *bár* lands, the uplands of the intervening *doábs* (land between two confluent streams). Various causes might be assigned for this effect, such as a change of levels, giving increased fall and therefore greater denuding power to the rivers. Action of this kind has probably had local effect, but we are bound to enquire whether the chief cause may not be one that is known to have operated, namely, the wholesale removal of forest vegetation. The effects of this change have been already called into account for the present desert condition of large tracts in this region; and another well known result of the same cause is that now under consideration. When rain falls upon a forest-clothed country, a very large part of it clings about the vegetation or is absorbed by the open soil at its roots. In the present state of this country the rainy season bursts upon a bare land baked hard by the fierce sun of the dry season, the water runs off the ground in torrents, and the channels, big and little, are scoured by floods that could never arise in such a region in its natural condition as unchanged by man. Thus the apparent discrepancy between the actual state of the rivers and the assertion that they have formed the land they flow through is converted into a confirmation of that view, for the effect corresponds in degree and in time with the known cause assigned for it. The uplands, which form the great *bár* prairies of the Punjab, are probably the remains of the general surface of the plains as it stood in prehistoric times.

The Thal.

The Thal, or desert formation often found capping the Bar lands, and which occupies so great an area in the Sind Ságar Doáb, is purely a wind-deposit, a continuous spread of sand-dunes. The apparent capriciousness of its distribution may be largely due to the unknown drift of the atmospheric currents; or it may be affected by unobserved obstructions, for once started sand-dunes tend to reproduce themselves, each one forming a back-water in which another may gather.*

The area of closed drainage.
Eastern plains.

Further illustrations of the same conditions are found in the eastern Punjab. Although the banks of the Jumna in its course from north to south form the summit level of the plains, and no drainage enters the Jumna from the west in this part of its course, yet it is in one sense misleading to speak of the right bank of this river as the watershed, for there is an immense tract of country to the west—almost the whole area between the Jumna and the Sutlej—from which no drainage ever enters the sea or other water

* Mr. Medlicott writes elsewhere: "They may even grow backwards against the wind, a check to which is the immediate cause of their formation; and thus the distant Salt Range may possibly have been the basis of the Sind Ságar Thal."

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The area of closed drainage.

Eastern plains.

basin. At the head, along the base of the Siwáliks, that area is 75 miles wide: but as the Sutlej immediately on leaving its gorge takes a course to north of west up to its confluence with the Beas near Sobraon, the area in question widens rapidly, so that on a parallel through Delhi the Jumna and Sutlej are 230 miles apart. Two considerable streams, the Markanda and the Ghaggar, and many minor ones, leave the hills within this area and flow straight away sea-wards; but they are nearly expended by evaporation and soakage before reaching the south boundary of the Punjab, and entirely disappear in the desert of Bikanír. They were once probably tributaries of the Sutlej when it formerly held a more direct southerly course; or more certainly of the Jumna if ever its waters, as is extremely probable, flowed to the western sea. Here then we can be certain that the whole work done by these rivers is expended within the area. For "time out of mind" none of the detritus from the hills for a length of at least 60 miles has left this ground, yet the surface here has not been essentially changed since the Jumna ceased to be the chief depositor. We are thus again led to the inference that this cannot have been very long ago.

The rivers have only recently ceased to deposit and begun to erode.

Saline nature of the well water in the area of closed drainage.

There is another feature of this case that requires notice. Modern primers of geography tell us what is the almost inevitable result of a drainage area having no outlet—that the enclosed basin becomes saline from the continuous evaporation of drainage water, which always contains some salt in solution. The only thing that can prevent this result is a sufficient underground percolation, which would have the same purifying effect as a surface outlet. It is clear that a similar result must ensue when the drainage water is dissipated without collecting in a basin, only the product will be more diffused. Now this effect is well marked in this peculiar area; all the southern part of it, where the final evaporation takes place, is extensively impregnated with saline matter, so that good drinking water is scarce. At Bhiwani, south of Hissar, the ground water was found to be brackish to a depth of 400 feet. This area of closed drainage forms nearly a third of the Punjab plains, the remainder being occupied in succession from east to west by the Jullundhur, the Bári, the Rechna, the Jetch, and the Sind Ságar doábs, with the narrow tract known as the Deraját between the Indus and the Sulemán range. To all these the foregoing general considerations are applicable.

Submontane tract. Absence of the *Tarai* zone.

There remains to be noticed but one point of contrast with the eastern or Gangetic area of this continuous formation. The zone so well known in the latter region as the *Tarai* is not distinctively represented west of the Jumna. It is a broad belt on the outer edge of the gravel slopes everywhere found next the hills. This coarse deposit absorbs water copiously along the foot of the hills, and so much of this as does not penetrate to the deep water-bearing strata finds its way to the surface again along the outer edge of the gravel beds, where also an abrupt change of slope occurs. In this way there is formed the second zone of peculiarly swampy ground known as the *Tarai*, the inner gravelly slope being known as the *Bhábar*, or forest zone. Although the gravel zone is of

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The Tarai only recently disappeared.

course found everywhere, and equally of course absorbs its full share of what water is spilt upon it, the *Tarai* is scarcely represented in the west. This may be partly due to a smaller rainfall, and so to little or no surplus escaping permanent underground percolation; but to a considerable extent it is due to the cause that has already been detected in so many ways, the destruction of the forest vegetation. It is not so very long since the climate and vegetation must have been very different from what they are now, when the Mogal emperors used to hunt wild elephant and rhinoceros on the borders of the lower hills of Jammu. The destruction of forest has, however, been much more extensive here than to eastwards, with the result that a greatly increased burden of detritus from the soft tertiary rocks of the lower hills is thrown upon the streams before entering the area of deposition. A great quantity of it is soon left behind, obliterating the conditions of slope required to produce a *Tarai* zone, the corresponding position in the Punjab being taken up by accumulations of sand which there is not water-power to carry further. For a description of the conditions under notice, reference may be made to Mr. B. H. Baden-Powell's account of the *chohs*, or sandy-bedded torrents from the Siwáliks in the Hoshiárpur district.*

The underlying deposits of the Punjab plains.

We have still to notice the depth or thickness of these deposits as a point of practical as well as of speculative interest. The surface deposits belong everywhere, as we have seen, to the human period. In a cutting near the head of the eastern Jumna canal, Colonel Cautley dug out a fossil town.† Everything below is concealed. It would seem that near the "outer" margin of the plains on the Himalayan side, a very close limit to the age of any beds conformably underlying the recent alluvium should be assignable: for the topmost beds of the Siwálik series, of latest pliocene, if not of pleistocene age, are tilted up vertically; yet they are indistinguishable in composition and texture from the actual river deposits. Disturbance of such magnitude must, one would think, have extended to some distance south of these outcrops, and thus have involved total unconformity of the Siwáliks with any beds that are still undisturbed within a considerable distance. If this were so, it would follow that any beds conformably underlying the surface deposits in the neighbourhood of the Himalayan margin must be long post-Siwálik. But, as will presently be shown, the disturbance to which the upheaval of the Siwálik is due probably extended to only a small distance from that margin.

Far from the mountains, anywhere within the protecting influence of the underlying hard rocks of the peninsula, it is evident from what has been said that the plains deposits might be in unbroken sequence with the whole tertiary system; and on this "inner" border of the plains, even at the small depth to which observation has access, beds having some small comparative antiquity occur in close relation with the surface deposits. In the lower

* Selections from Records of Punjab Government, new series, No. XV, 1879. *See also* Records of Geological Survey of India, Vol. XIV, p. 228.

† Journal Asiatic Society, Bengal, III, p. 43, 1834.

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reaches of the Jumna, between Agra and Allahabad, where the river has eroded its channel to a depth of 100 feet below the level of the adjoining plains, bones of extinct forms having some affinities with those procured from the upper Siwálik strata have been found in perfectly undisturbed clays.

Formation of tertiary fluviatile deposits in the plains area.

Any surmise upon the underground features of the plains deposits can only be derived from the view formed of antecedent conditions as indicated by the features of adjoining areas. On the peninsular side there is good evidence to show that, so far back as in immediately pretertiary time, the drainage flowed from the south towards what is now the Gangetic basin: the whole northern scarp of the Vindhyan plateau existed at that time in approximately its present position. The Deccan trap poured over that scarp on to the gneissic area of lower Bundelkhand. How far it may have flowed over the low ground in that direction it would be impossible to say; on the plateau it does not seem to have reached so far north as Gwalior. The total absence of any remnant of tertiary rocks on this border of the peninsula suggests that it was then out of the reach of deposition rather than that all such deposits have been since removed; but it would seem pretty certain that this drainage basin was part of that in which the eocene rocks of the Himalayan border were laid down. Only the lower stage of that series is marine; and the muddy character of these beds, contrasting with the clear limestone of the same age in the western Punjab, suggests estuarine conditions requiring a southern bank far to the north of the present south boundary of the plains, and of course also a limiting land in the actual Himalayan area. Already in nummulitic time these marine bottom-beds became mixed with and soon permanently replaced by others of distinctively Sub-Himalayan characters, consisting of fluviatile deposits with terrestrial and freshwater fossils; and these conditions have lasted throughout the Siwálik epoch to the present day, for as has been said the top Siwálik strata seen at many places in the Punjab are absolutely indistinguishable from those of the plains. These middle and upper tertiary fluviatile deposits were independent of the sea level and would have spread over the whole basin according to its contour, and equally to the south in the valleys of the northern slopes of the peninsular area now concealed beneath the plains. From the foregoing observations it would appear that the Sub-Himalayan eocene marine basin was probably a narrow one; but that the supervening upper tertiary fluviatile deposits may have stretched southwards to an indefinite distance.

Effect of the upheaval which raised the Siwáliks upon the underlying deposits of the plains.

To the foregoing consideration of the original conditions of the basin there must be added what can be said regarding the Himalayan disturbance as affecting the floor, and therefore the whole condition, of the plains deposits. The extreme unconformity already mentioned as occurring between the horizontal plains deposits and the vertical Siwáliks along the Himalayan border does undoubtedly establish an immense lapse of time (as reckoned in historical periods) between the two. But the inference as to how far this condition of unconformity extends beneath the plains

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to the south of the actual boundary depends upon the view taken of the process of disturbance. It is difficult to resist the *primâ facie* impression from the sight of an immense thickness of stratified rock turned up on end that great violence must have attended such results, and hence that the effects must have extended to far beyond the point where such intensity is exhibited. It was upon such natural impressions that the cataclysmal theories of the early geologists were founded. In the present case, the plausible supposition from such a point of view would be that an elevation of the Himalayan area coincident with the contortions of the Siwálik strata had first resulted in a great valley of erosion from the mountains to the sea, forming a clean-swept basin for the deposits which now form the plains.

Practical importance of the question.

To give meaning to this seemingly useless discussion it may be well to point out that it forms the only rational approach to the practical question often asked—where in the plains and at what depth would there be a prospect of success for an artesian boring. If the supposition just noticed might be counted upon, a very favourable answer could be given to this question. The base of the deposits would then be everywhere within reach; that base would generally consist of coarser materials, such as would form a capacious water-stratum; and it would be in continuous connexion with the present upper zone of gravel beds at the foot of the hills, where copious absorption of water occurs.

Siwálik upheaval probably very limited in its effects

Careful observation and reflection are, however, against that *primâ facie* supposition. It will be shown that before the disturbance of the Siwálik rocks (*i.e.*, during the Siwálik period) the Himalayan rivers, great and small, flowed just where they now do in the mountains; so that there is nothing to support the supposition that any great elevation or violent movement of any kind accompanied the disturbance of the Siwálik rocks; for they probably were tilted up so slowly that the main rivers could *pari passu* erode their gorges across the rising strata. Another fact of corresponding import is found in the form taken by the Siwálik strata under disturbance. The *dúns*, or longitudinal valleys occurring so constantly inside the Siwálik ranges, are generally formed of the topmost Siwálik strata in a more or less horizontal condition, rising by a gradual increase of dip to form the range outside the *dún*, while on the inner side they either abut abruptly against the rocks of the inner range, or else are bent up sharply to form that range. Such a feature strongly suggests the probability that the final limit of the disturbance may be no less abruptly marked; so that beyond the extreme verge of the vertical Siwálik strata these same strata may have remained permanently in their original gentle slope of deposition, and would thus be in conformable sequence with the most recent deposits of the plains within a very short distance of the hills. It is independently intelligible that the slow compressing force to which the bending of the strata and the consequent rise of the hills were due would expend itself to the utmost on each flexure before giving rise to a new one.

Such a process would of course involve great erosion of the Siwálik strata in the immediate region of upheaval; and there is

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abundant evidence of this, not only in the river gorges and the deep ravines of the minor streams, but along the whole outer edge of the hills, where, as a rule, the uppermost gravel beds of the plains rest upon the edges of low Siwálik strata near the axis of the flexure, the whole of the outer and steeper side of which has been removed. Under the supposed conditions of disturbance this denudation would not have reached far; so that within a short distance there might be completely conformable sequence between the Siwálik deposits and those of the actual plains.

Artesian boring at Ambala.

One important direct observation has been made upon the underground constitution of the plains, in the boring for an artesian spring at Ambala, to a depth of 700 feet. No gravel bed or other water stratum was met with, and the boring ended in stiff clay. If this section could be taken as representative, it would be conclusive evidence against the supposition of these deposits lying in a simple post-Siwálik basin of erosion; for the bottom of such a basin must at Ambala be within a much less depth than 700 feet, and the basal beds in such a basin must as a rule be coarse, porous, and water bearing. It is easy to explain a possible exception to this rule; and Ambala is just in the position where such an exception would be most likely to occur. It is about 20 miles from the foot of the hills, and this is beyond the distance to which gravel is now swept by the small streams and the rain-wash on the steeper slopes near the hills. It is only within the range of the great rivers, in the deeper parts of the supposed basin of erosion, that coarse deposits must occur somewhere in almost every section, especially at or near the base; and in river-formed deposits such as these, the range of the great rivers embraces in time more or less the whole area. Ambala, about midway between the Jumna and the Sutlej, and so near the hills, is just in the position most likely to escape that influence, as the whole growth of deposits might be directly from the hills, or by overflow of finer sediment from the main rivers. In this way there might be nothing there to mark the bottom of the basin or surface of erosion in so small a section as that given by a boring; and thus the passage from the recent plains deposits into beds of such similar composition as are those of the upper Siwáliks would not be noticed. It can, however, be affirmed that the boring did not reach beds that had undergone any considerable disturbance, for the frequency of alternation of beds in the lower part of the boring was as great as in the upper part, whereas a very moderate tilting of the lower beds would have given a perceptible apparent thickening of the several strata passed through by a vertical boring.

Inconclusive nature of the results.

Changes of level consequent upon transfer of matter from the mountains to the plains disturbing local equilibrium.

There is yet to be taken into account a consideration of great weight in this discussion. It was long ago suggested by Herschell, in seeking for a prime mover of the forces by which crust movements are effected, that the familiar process of denudation by the continual removal of matter from steep elevated tracts and the deposition of it in adjoining low ground evidently disturbs the equilibrium of strain beneath those areas, causing a tendency to elevation in the former and to depression in the latter. Recent researches upon the nature of the earth's rigidity entirely confirm

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Changes of level consequent upon transfer of matter from the mountains to the plains disturbing local equilibrium.

that inference; and it is the obvious explanation of the constantly observed fact of depression in deltas. Borings in the delta of the Ganges at Calcutta have discovered land surfaces far below the present sea level. Now these conditions occur in a very concentrated form along the fringe of the Himalayan border. An enormous amount of detritus is annually swept down from the mountains, a relatively large proportion of it being from the softer rocks of the Sub-Himalayan hills; and a relatively large proportion of that detritus is deposited in the upper marginal region of the plains. It thus becomes a matter of certainty that depression to an unknown extent has taken place in this latter area. This view considerably modifies the inference to be drawn regarding the lower beds in the Ambala boring if based on the supposition of extensive elevation and erosion. The probability would now seem to be that the boring did not reach beds of Siwálik age. It is evident that these later conclusions regarding the underground relations of the plains deposits render more difficult than ever any speculation as to the position or depth of an artesian source, although by no means shaking the probability that such sources occur there.

SECTION D.—THE SALT RANGE AND ITS WESTERN EXTENSION.*

The three divisions of the Salt Range.

Their geological formation.

The Salt Range, both cis and trans-Indus, possesses geological features peculiarly its own. It presents a complex arrangement of strata affording sections almost entirely different eastwards towards the Jhelum from those westward near the Indus, and both differing considerably from the sections presented by the trans-Indus extension of the range. This triple or tripartite development of the rocks may be compendiously expressed as follows:—

Comparative Table of Formations.
(Natural Order)

	Trans-Jhelum.	Cis-Indus.	Trans-Indus.
		Quarternary.	
Alluvial and sub-recent.	Rainwash and superficial deposits.	The same	The same.
Post Tertiary ...	Conglomerates and clays. (*unconformity*	The same ... .. *throughout*).	The same.
Cainozoic.			
Pliocene ...	Upper Siwalik. Conglomerates, drab and pink clays with bones and reptilian remains.	Upper Siwalik. The same.	Upper Siwalik. The same.
	Lower Siwalik. Gray sandstone and red clays with bones.	Lower Siwalik. The same.	Lower Siwalik. Gray sandstones with bones, clays subordinate, seldom red.
Miocene ...	Nahan or Murree Beds Greenish gray sandstones, some red clays, reptilian remains and fossil wood.	Nahan or Murree Beds. The same slightly represented.	Nahan or Murree Beds. The same scarcely represented southwards.
Eocene ...	Nummulitic Limestone Large gastropods, bivalves, echinoderms & alveolina, &c., &c (locally absent).	Nummulitic Limestone The same.	Olive clays, pale sandstones, conglomerate of limestone overlying—Pale limestone (locally absent).
Eruptive ...	... ...	... ...	Traps, ashes, &c., in Subáthú beds of Thall on Kurram river.

* This sketch is by Mr. Wynne. For his more detailed report on the Salt Range, see Memoirs of Geological Survey of India, Vols. XI, XIV, XVII.

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Their geological formation.

Comparative Table of Formations—(Continued).

(NATURAL ORDER.)

	TRANS-JHELUM.	CIS-INDUS.	TRANS-INDUS.
MESOZOIC.			
Cretaceous ...	OLIVE GROUP sandstones and shales chiefly *Terebratulæ* and bivalves obscure.	Absent or unrecognisable.	Whitish sandstones, upper part of a dark earthy zone containing a neocomian ammonite.
Jurassic ...	Absent. ...	VARIEGATED GROUP red and white and variegated sandstones, &c.	Thin limestones and shales under dark earthy zone. Ammonites, bivalves, &c.
		Ammonites ? Belemnites, &c.	Variegated soft sandstones and clays, obscure plants.
Trias ...	Pseudomorphic salt crystal zone, red flaggy sandstones, red clays, perhaps triassic.	Gray limestones, calcareous sandstones, gray marls, ceratites, &c.	Gray limestones, thick marls, dolomites, &c., ceratites.
PALÆOZOIC.			
Carboniferous ...	Unknown ...	Gray and magnesian limestone, calcareous sandstone, sh les, *Productæ*, *spiriferæ*, *Bellerrophon*, *goniatites*, *&c* , *&c*.	The same.
Infra Carboniferous.	Absent or on the horizon of a group of Magnesian sandstones ?	Speckled sandstones, red and lavender clay.	Red or purple boulder clays, sandstones and gypsum and thick dolomite.
Silurian ...	Black clunchy shales, &c., with Obolus or Sephonotreta.	Absent	Absent.
	Purple sandstone ...	Absent locally ...	Purple sandstone (? same)
	Salt marl, salt gypsum and red marl.	The same ...	The same at Kalabagh only.
Eruptive ...	A few exposures in upper part of red marl.	Nil.	Nil.

It will be seen from this list that the rocks embrace a very considerable series representing palæozoic, mesozoic and cainozoic as well as more recent deposits. Throughout the whole up to the bottom of the post-tertiary beds there is a singular absence of marked unconformity, trifling indications of discordance having only been observed locally between the jurassic and cretaceous horizons trans-Indus, and again at the local base of the tertiary rocks, mainly of newer tertiary aspect, where they are in junction with triassic beds in the Kiri Khasor and Nala Koh ranges, trans-Indus.

Speculation as to the geological history of the system.

There is much inequality of deposition on the eocene horizon, and this has been held by some to mark a great period of disturbance and arrested deposition; but while the possibility of discordance entirely invisible may always exist, the absence of its usually prominent signs over so large a region is a fact not easily set aside. It has also been urged that there is represented in the Salt Range a sort of transition between the rocks of the Peninsular and those of the Himalayan region, from a marine facies westward to a freshwater or continental state of things eastward. Variety certainly is present; but where so much of the older eastern Salt Range series is quite unfossiliferous, it is scarcely fair to presume that if organic remains were present they would be other than marine, especially as the single ancient *Obolus*, or whatever it may eventually be called, which has been found there, is certainly marine. Leaving these points to hardy speculators, it will be more useful

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to indicate briefly tangible facts regarding the rocks and structure of the region.

Nature of the evidence; and difficulty of the enquiry into the structure of the region.

In all the southern acclivities, in the profound rocky gorges by which its escarpment is intersected, and over its summit crags and northern sides, there is no want of sectional or other evidence from which to ascertain the composition of these Salt Range mountains from the banks of the Jhelum to the somewhat indefinite frontier of the Afghan uplands to the west. The chaotic state of the southern escarpment, however, requires extreme caution amongst its subsided masses, to disentangle the original arrangement of the beds.

This confusion appears to be equally due to the presence of the great saline deposits forming the base of the series, to the alternate recurrence of friable and more solid rocks, and to the peculiar climatic conditions of the country, subject to extremes of drought and wet and wind at distant intervals, and not unfrequently a desert cold-producing frost at night, though the heat in the day-time may have been very great; and action of torrents and all the meteoric forces which can abrode rocks and disintegrate mountains are the necessary consequences of such a state of things.

Saline series.

The lowest and oldest rock known in the Range is the great rock-salt deposit; but at a distance of some 35 miles to the southward, presumably older sub-crystalline and slaty beds occur in the Karána hills, according to Fleming and Theobald * * (Jour., As. Soc., Bengal, Vols. XXII and XXIII).

The geological history of the salt is as obscure as is usually the case; and, as in other places, it is found to be overlaid by massive beds of gypsum; indeed the red marly rock which marks the position of these minerals is itself largely gypseous and often saline. Although the thickness of the salt, where most accurately known, as at the Mayo mines, is enormous, the very conditions under which it may probably have been accumulated in detached basins preclude the inference that it extends everywhere beneath the Range as one vast sheet. The local disturbances too may naturally point to its extensive removal by percolation of fresh water. Notwithstanding this, however, its presence at numerous localities almost along the whole southern foot of the mountains for 116 miles, and often with thick outcrops, leaves little necessity to qualify the assertion that the supply is practically inexhaustible.

Outturn and quality of salt.

The annual records show that the outturn of salt from the Range equals in maunds 12 to 13 lacs, producing a revenue of 40 lacs of rupees, or £400,000 sterling yearly.

Potassium salt.

The salt is of reddish or whitish colour in thick bands of great purity, alternating with other thick bands of more impure and earthy character, called by the miners *kuller*. Between some of the strata at Khewra, Mayo mines, a stratum of potassium salt was found, having a thickness of a few feet. From more recent workings it appears the deposit had a lenticular shape, and was limited in size to some 600 superficial feet as estimated by Dr. Warth, formerly Collector at these mines. Its presence indicates the possibility that other deposits of this valuable salt might be found if sought for. The salt in its crude form is a mixture of

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sylvine, or that form of potassium chloride which is now the principal commercial source of potash, with kieserite (magnesium sulphate) and common salt. (*See* Manual of Geology of India, Vol. III, page 501; Records, Geological Survey of India, Vol. VII, page 64).

Bitumen.

The rock-salt of the range, though not known to be itself bituminous, is associated with layers of highly bituminous shale in the over-lying gypsum at Khewra.

Volcanic tufa.

Near the place where this shale occurs, and in a few other situations on apparently the same horizon in the eastern part of the range, there is an interbedded mass of volcanic tufa, porphyritic by the presence of numerous small crystalline needles of a semi-transparent mineral-like decomposed actinolite. Together with this are some feet of lavender-coloured clay, occasionally containing talcose veins; it is used as soap by the natives.

Saponaceous clay.

Trans-Indus salt.

A notice of the neighbouring salt region of Kohat may appropriately be given here for the sake of comparison. The last known exposures of the Salt Range palæozoic salt occur at Kálábágh on the Indus; and for some nine miles up the Lún nala in a north by west direction there are others at intervals. But further into the Kohat district in this direction another kind of rock-salt occurs in great quantity, and in numerous exposures, for a distance of 40 miles amongst the tertiary hills on both sides of the Teri Toi river. The general character of this Kohat salt is a more or less crystalline mass of different tints of gray when not quite transparent, with numerous transparent blotches. In some places it is dark, smelling strongly of petroleum. A few bands only contain sufficient dark silty clay to render it unsaleable. No such impure earthy bands as separate the Khewra salt beds occur throughout the district. The salt is overlaid by white and gray gypsum and gray or greenish gypseous clays, generally much confused as to stratification, and in this resembling the Salt Range marls, but the aspect and colour of the gypseous strata is as distinct as possible in the two regions. The gypsum varies in thickness and occupies large areas over the axes of anticlinal curves. Associated with it are some layers of alum shale, and it is sometimes black and bituminous like the salt.

Alum.

Overlying the gypsum is a thick deposit of blood-red clay having a few sandy layers, and near the top a double band of coarse purple, sometimes conglomeratic sandstone containing a few fragments of fossil bones, and this is succeeded by the eocene limestone.

The Kohat salt more recent than the Jhelum salt.

In all the numerous exposures of the Kohat salt-field no older rock than the salt has been discovered, and both it and the gypsum as a rule follow the curves of the adjacent newer limestone. Rock-salt may be of almost any age, but this apparent conformity and the utter absence of all proof that the beds are older lead to the inference that this salt, gypsum, &c., are of nummulitic age or immediately antecedent thereto, the supposition being less violent than the assumption that this salt series is contemporaneous with that of the Salt Range, while all the intervening formations from the infra-silurian sandstones to the jurassic or cretaceous inclusive should have disappeared by gradual thinning out. It is difficult

to conceive of conditions which would admit of such a series tranquilly surviving through all the changes of eight or nine vast geological periods belonging to palæozoic and mesozoic epochs; while the geographical distance from one or more of these frequently widespreading if detached formations appears hardly sufficient to account for the absence of them all.

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Extent of the trans-Indus Salt beds.

This rock-salt occupies a very prominent place in some of the sections. In the Bahadur Khel anticlinal it may be continuously traced either uncovered or slightly concealed for a distance of about eight miles, having a width sometimes exceeding a quarter of a mile and an estimated thickness at one place of more than 1,000 feet. It is exposed along the valley of a small river sometimes forming hills 200 feet in height, almost entirely composed of bare salt beds. This is probably one of the largest rock-salt exposures in the world, and it occurs at but a small and narrow part of one of the elongated salt tracts containing numerous other large exposures of the mineral.

The average revenue from the nine quarry workings open when the country was examined amounted to Rs. 56,290 annually (roughly about £5,000), the cost of the salt, exclusive of miners' charges, being from 2 to 4 annas per maund, as compared with the 3 rupees 1 anna levied in the Salt Range for the same weight.

Purple sandstone.

To return to the Salt Range series: the saline group of that region is immediately overlaid by an unfossiliferous thick mass of dull purple sandstones, traceable with diminishing thickness as far westward as the neighbourhood of Sakesar, the culminating peak of the range cis-Indus, with a height of over 5,000 feet above the sea. A very similar sort of purple sandstone reappears far to the west by south, near the further extremity of the Kirí Khasor ridge, and is there also associated with gypseous rocks, but the exposures are too few to prove its identity. The purple sandstones work well for building purposes, as may be seen in the monument composed of it which has been erected on the battle-field of Chillianwala, and their massive scarps are conspicuous in most of the southern cliffs of the eastern part of the range.

Obolus zone.

It is here immediately succeeded by a dark gray or blackish shaly and clunchy zone, containing in a few localities many fairly preserved forms of an *Obolus* or *Siphonotreta* as determined by Dr. Stoliczka; hence the containing rock and all below it have been assumed to be of not later than Silurian age. These dark-coloured shales accompany the purple sandstone to the westward nearly as far as the later group is recognised, but slowly split up and lose their definite east Salt Range aspect.

Magnesian sandstone.

They are overlaid by two different groups of the series. In the east they are succeeded by one of its most characteristically separate zones, that of the magnesian sandstone, a pale, hard, compact rock, bearing ripple marks and some fucoidal impressions, but no determinable fossils; a rock that from its strength shows prominently in the cliff-sections of this eastern part of the range.

Speckled sandstone.

Further west the *Obolus* beds are as closely succeeded by a thick group of whitish and speckled unfossiliferous sandstones with occasional red bands or dark boulder clays to the westward, full of

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Salt-pseudomorph zone.

crystalline rounded masses. Pale lavender-coloured clays commonly form its upper part, the group appearing to overlap the attenuated western termination of the magnesian sandstone.

Where this appears to take place in the cliffs about Makrach, the next sectionally succeeding group to the magnesian sandstone disappears likewise from the series. It is composed of red, pale, and variegated sandstones, clays and shales frequently abounding in pseudomorphic impressions of the cubical and hopper-shaped crystals of common salt. Its age cannot be fixed for want of organisms; but it has been referred to the triassic period as a mere surmise, though from its colour and arenaceous or earthy aspect it might equally claim to represent the jurassic beds to the west. Where the last group ends there commences to enter the series, as if upon the same or an intervening horizon, the earthy fringe of a mass of limestones, often magnesian shales, sandstones, and occasionally conglomerates, passing into thinner bedded limestones with thick gray clays above. This new accession gains steadily in thickness and importance westward, limestones predominate, and replacing the harder bands of the east give to many of the western cliffs and undercliffs their craggy aspect. The lower part of these limestones, &c., abounds in carboniferous fossils of the well known British kinds, while the upper portion furnishes quantities of *Ceratites* and other triassic forms. The two life zones representing Palæozoic and Mesozoic time, here uniting to form one physical and structural group, accompany each other from where the ceratite band is first distinctly recognised somewhat west of the Sungle-waan, in all the further exposures of the carboniferous and triassic zone, on towards the Indus, where both are lost and confused, but re-appear together in the Kálábágh mountains, and are largely exposed in the Khasor range as well as in the vicinity of the hill station of Sheikh Budin trans-Indus.

Carboniferous and triassic limestones, &c.

Jurassic.

In direct succession to this limestone belt westward come the variegated red and white sandstone clays and yellowish or gray limestones of the jurassic formation. They are first recognised in the grand glens and gorges southwards of Sakesar, and continue prominent in all the immediately cis and trans-Indus sections of any depth except those of the neighbourhood of Isa Khel, and of the Kirí Khasor ridge till near its south-west termination.

Like almost every other group of the country the jurassic beds change, and the mixed calcareous and arenaceous character they exhibit eastwards assumes in the most westerly and intermediate exposures a much more definite double aspect, the red and white and variegated beds forming the lower part of the series and the yellowish and gray calcareous layers being grouped together above. The thickness of the formation too increases, but does not prevent the total or almost entire disappearance of the whole group for a long distance in the Kirí Khasor ridge, where a striking case occurs of the prevailing tendency to overlap in all the stratigraphic arrangements of the country.

In the easterly parts of this formation the fossils are more obscure or scarce than in the trans-Indus localities, but there is an interesting record of the discovery of well-preserved fossil plants

near the Bak ravine, not far from Musakel, by Dr. Fleming, the locality of which, however, has not been re-discovered. In the localities near Kálábágh and Sheikh Budin numbers of belemnites, ammonites, with gastropodous and bivalve shells, have been found; and in some places fossil tree trunks are so numerous as to have been collected and used as coal on the Indus river steamers.

Cretaceous.

The next or cretaceous group of the series is represented in recognisable form only in the easterly and westerly portions of the district, and in these places by rocks of very different appearance. To the west, trans-Indus, thick soft yellow sandstones at the base of the eocene with few traces of fossils overlying a thick mass of dark clunchy shales, containing a neocomian ammonite, partly represent the cretaceous horizon; but the sandstone seems physically more connected with the overlying eocene, and the dark shale contains jurassic fossils in its lower part. In the eastern half of the cis-Indus Salt Range the cretaceous formation is represented by a certain dark olive group of sandstones, flags, and shales or clays with peculiar shaly boulder beds of semi-trappean look, with great rounded (and in one case glacially striated) blocks of crystalline rocks: with these there are a few deep red earthy and flaggy bands. Fossils are scarce here also; some obscure plants, fish teeth, bivalves, and a determinable terebratula, where the zone approaches the carboniferous limits, being the principal palæontological evidence obtainable.

These olive beds are supposed to represent a more largely developed mass of somewhat similar character beyond the Dera Gházi Khan frontier; and they seem much more nearly connected with the overlying eocene than with the groups on which they rest, the downward succession being to the eastward into the red flaggy and earthy salt-pseudomorph zone, further west into the speckled sandstone, and near the central part of the Salt Range proper, into the fringing earthy and calcareous rocks of the great carboniferous limestone; while the relation to the overlying eocene, or in its absence the succeeding tertiary bands, remains constant. This clearly proves, notwithstanding the apparent parallelism, the importance of the break represented by the overlapping succession.

Eocene.

Throughout the Salt Range region and its extensions in a westerly direction the series above described is generally covered by the widely though fugitively distributed white nummulitic limestone. In some localities, however, it is totally absent. Sometimes it is perhaps represented by a few layers of conglomerate formed of its own limestone pebbles, but usually it forms a massive cap to all the underlying rocks, varying in thickness up to 800 or 1,000 feet. A certain uniformity of aspect prevails, but this is subject to some local variation, more in the association of other beds with the limestone than in the mutability of the rock itself.

Coal.

Thus, in the eastern part of the Salt Range, where the group in places dwindles to a few feet, it is found to include layers of whitish friable sandstone below alternating with red bands, and to contain amongst these layers a band of coal and coaly shale of varying quantity and quality. It is generally pyritous, but sometimes would afford excellent fuel if the cost of extraction were not

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The Salt Range and its Western Extension.

Coal.

likely to interfere with its value. The deposit is rather extensive, appearing in numerous places from the eastern to the western regions of the range and even beyond the Indus; but the thickness of the useful part of the coaly band seldom exceeds from one to three feet. To the east the carbonaceous band forms a basal member of the eocene group, but in the opposite direction (in the Bak ravine) it lies nearly in the middle of the limestones, and the sandy basal portion of the group is in this region almost suppressed. Another somewhat distinctive member of the lower nummulitic layers is a sort of hematitic breccia. This also occurs at more than one horizon further west, and indeed very closely resembles other ferruginous brecciated bands occurring locally in the carboniferous and jurassic formations.

Limestones.

The main mass of the limestones is of whitish or pale yellow colour, sometimes crowded with nummulites or alveolina, and sometimes containing very large ill-preserved casts of echinoderms, bivalves, and gastropods. Its uppermost layers in the east Salt Range are of mingled calcareous arenaceous and argillaceous character, amongst which or intervening between them and the stronger limestone is a conglomeratic layer formed of hard limestone and cherty nodules containing nummulites.

Far to the westward, trans-Indus, somewhat similar conglomeratic bands occur in the lower part of the groups as well as above: in the former case associated with the yellowish white friable and more massive sandstones which here seem to link the eocene and cretaceous horizons, while those conglomeratic layers which occur near the upper limits of the eocene groups are associated with gray and greenish shaly clays not unfrequently present in the Subáthú group.

The last of the nummulitic limestone of the Salt Range region is seen in the Maidan range trans-Indus north of the river Kurram, where some of its thickest exposures occur. It is there covered by the anticlinal folds of the newer tertiary rocks, and where it should reappear in the southern sections only bands of conglomerate containing nummulitic or alveolina limestone pebbles are met with.

Kohat eocene.

To the northward of this country however, in the Kohat district, where the prevailing newer tertiary beds are pinched into anticlinal and synclinal folds corresponding with the hill and valley structure of the region, the nummulitic limestone is frequently exposed, forming the interiors of several ellipsoids, and resting generally upon a zone of deep red clay which immediately overlies the gypseous upper portion of the local saline group.

The nummulitic limestones here are generally thinner as a group than in the Salt Range. They are often crowded with alveolina, nummulites, pelecypoda, gastropods, &c., and contain frequently deep yellow magnesian looking bands, and often appear to be intercalated with the adjacent red and greenish sandy beds of Dugshai or Murree character, but the intensity of the folding the rocks have undergone renders it almost equally probable the appearance is due, as it is certainly in some cases, to contortion.

In the westerly portion of some of these ellipsoids the eocene limestones are closely associated with greenish clays like those in

Kohat eocene.

the eocene strata flanking the outer Himalayan hills, and these clay rocks sometimes contain sandy layers rendered conglomeratic by the presence of nummulitic limestone pebbles enclosing nummulites, so that the occurrence of an apparently derived detrital rock of this kind cannot always be taken as evidence of later general age than the rock of which it is formed. Bearing this in mind, it seems not unlikely that the conglomeratic or pebbly layers found at the base of the tertiary beds in the neighbourhood of the Sheikh Budin *gund* represent some stage of the eocene period, a surmise that might even be extended to the more heterogeneous detrital accumulations of pre-tertiary rock, fragments of which form the floor of the tertiary series in the northern part of the Kirí Khasor ridge.

General view of the pre-tertiary series.

We may now make one or two general remarks in connection with the Salt Range or extra-Himalayan pre-tertiary series. The wide range of these deposits through so much of geological time intensifies the peculiarity that strongly-marked discordances, such as are found in other regions, should be absent, the breaks in the succession elsewhere marked by discordance seeming here to have been recorded in the less abrupt form of interrupted succession known as overlap. As to what lengthened periods of duration these overlaps may signify, or how slight may have been the local arrest of deposition, it is impossible to arrive at accurate conclusions; it may even be that some of the isolated deposits are more nearly contemporaneous than there is evidence to prove.

The salt marl and gypsum forming the floor of the series are overlaid by the purple sandstone, to which succeed two other conformable deposits, the *Obolus* and magnesian sandstone groups not known at any place to rest upon the saline group, and therefore to be considered local. These three groups are all overlapped by the sub-carboniferous speckled sandstone, which at one or two isolated and faulted localities in the plateaus of the range, as well as in many of its southern and western sections, next succeeds the gypseous and saline groups. Amid the complications and dislocations near the Indus the speckled sandstone may be itself suppressed, unless faults prevent its appearance between the same saline group and the carboniferous limestone.

The latter group with its accompanying ceratite beds, strongly developed in the west and trans-Indus, dies out in an easterly direction, the triassic portion disappearing first; and the last fossiliferous representative of the carboniferous limestone is situated in the same position below the overlapping cretaceous olive group, as is the red flaggy salt-pseudomorph group of the conformable eastern series. This olive group, dying out westward and but feebly represented trans-Indus, is overlapped by the eocene limestone, which also overlaps the termination of the triassic and jurassic groups, and is itself again overlapped by the newer tertiary detrital beds. These at the east of the range may be found resting on the *Obolus* band and away to the west trans-Indus upon the ceratite group. Thus, although there are but meagre traces of absolute unconformity, there are at least four prominent cases of overlap or suspended deposition.

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Himalayan District—Tertiaries.

General view of the pre-tertiary series.

Another point of interest connected with the geology of the region is the reappearance of detritus foreign to the whole of this part of the country in thick boulder clays or thinner conglomeratic beds scattered throughout the series. The crystalline blocks found in the sub-carboniferous deposits of the Khasor range and cis-Indus western Salt Range proper are well rounded far-travelled fragments, often of considerable size, and sometimes polished or even faintly striated as if by glacial action. No similar parent rocks are as yet known amongst the adjacent Himalayan or neighbouring mountains; but the circumstance that these boulder beds occur more or less in the vicinity of the Indus points to the possibility that this ancient river, which transported materials so largely to form the conglomerates of the newer tertiary Siwáliks, may even at the far earlier period indicated have existed and carried down this rounded detritus from unknown regions. Failing this, their source must be sought in lost hills or shores buried beneath the southern plains or connected with the peninsular system of India.

Passing over numerous conglomerate layers in other parts of the series, containing crystalline fragments very similarly constituted, boulder beds recur again in the olive group, as previously mentioned, with distinct evidence of contemporary glaciation, but yielding no more information as to their source. One enormous block of red granite, supposed to have been derived from this group, lies eastward of the Collector's house on the salt-marl of Khewra near the Mayo mines.

SECTION E.—HIMALAYAN DISTRICT—TERTIARIES.

Punjab Himalaya peculiarly interesting;

The Himalayan districts of the Punjab comprise an area of peculiar interest in Himalayan geology. In Kángra, Kulu, and the Simla region there is a very complete display of the great sub-Himalayan system of tertiary rocks, and also the most favourable exposure of the series of limestone slate and schists forming the outer or lower Himalayan mountains south of the great snowy range; while in Spiti the fossiliferous palæozoic and secondary strata on the north of the range are well represented.

due to its terminal position in the range.

These advantages of the position are due to the fact that we have here the beginning of the end of the Himalayan range proper, the snowy mountains of Hindústán. The most striking feature of the case is the complete obliteration here of the broad region, 40—50 miles wide, of lower mountains ranging up to 12,000 feet that everywhere to the east skirts the south of the main range, comprising the district of Kumaun, the kingdom of Nepal, and the territories of Sikkim and Bhutan. The Simla area is the most north-westerly portion of that region. A really well-shaded map would mark this change sufficiently by the corresponding abrupt change of elevation; but on a geological map the feature is most distinct. At the eastern edge of the Punjab, near the Jumna, the sub-Himalayan tertiary zone is only about 10 miles wide, representing thus the condition it maintains eastwards to the far upper end of the Assam valley; but in Kángra this zone is nearly 60 miles wide, due to encroachment on the position of the lower Himalayan region.

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Extinction of the lower Himalayan region a structural feature.

The change is altogether structural, and not due to secondary causes such as denudation. The strike of the rocks on both sides of the tertiary boundary conforms to it along its bend northwards, showing it to be an aboriginal feature of the Himalayan elevation. There is ample corroborative evidence of this view in the main range itself. In the gorge of the Sutlej above Wangtu the massively eruptive granitic rocks in the axis of the range, as everywhere observed to the east, are still in force, and pass north-westwards into the mountains of Waziri Rupi; but on the western side of this massif, in the deep Kulu valley cut by the Beas right across the axis of the main range, no such rocks have been found. The ground has not been closely examined; but it is certain that the axial intrusive rocks can be but very feebly represented, if at all. The flexures and fractures involved in such a mountain range are so great that their total extinction in so sudden a manner would be matter of surprise; and in fact the great range does from here split up into three minor ranges, each with its gneissic axis, but all of which become absolutely extinct within the basin of the Jhelam. The southernmost of these is the Dháola Dhár range overhanging the Kángra valley, a revival of the same granitic rocks directly on the prolongation of the great Himalayan chain. But here the tertiary boundary is found close at the base of this axial range, within two miles of the granitic rocks. It is this immediate contiguity of comparatively low (2,500 feet) undulating fertile ground with a lofty (15,000 feet) precipitous mountain range that constitutes the peculiar beauty of the Kángra valley.

Fourfold division of the ground.

The foregoing outline of the leading features suggests at once a fourfold division of the geological description: the sub-Himalayan tertiary zone; the lower Himalayas; the axial rocks; and the Tibetan area.

Sub-Himalayan tertiary region how produced.

The name sub-Himalaya is primarily an orographical term, used to denote the lower hills on the border of the mountain area. Such a gradation of elevation is in the first place a result of the elevatory process itself, in which there is a general tendency to a line of maximum effect in a more or less central position. This result is further wrought out, and would to a great extent be independently produced, by the second agency of hill formation, the wearing action of atmospheric waters to which all the detail of surface configuration is due. Drainage must flow outwards from the crest of elevation, and deepen as it goes, thus increasing the effects of erosion in the outer zones. Finally, the conditions of the ground generally lend themselves to the completion of this feature: in a simply upraised stratified mass the topmost beds must in time undergo complete removal from the higher parts, and be reduced to a zone of outcrops at the margin of the area; and as they are the newest and least consolidated part of the whole mass, they are specially liable to disintegrate. Still with a regular sequence of formations there would be an equable gradation of elevation, and the separation of a border zone of lower hills would be more or less arbitrary. Such is not the case however with the sub-Himalayan zone; the change is abrupt and very decided. This is due to several causes, the first of

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which may be noticed here; it is that below the tertiary series there is a great break in the sequence of stratified rocks, the next oldest being much older and much harder, so that the contrasting effects of denudation on the contiguous masses is very marked.

Partial pre-tertiary elevation.

This tertiary series is "sub-Himalayan" in another and a more intrinsic sense—that of having been deposited at the foot of the Himalaya, and out of Himalayan *debris,* as is quite demonstrable for the major portion of the series and more or less so for the whole. To this statement we may at once confront another—that the Himalayan mountains were formed in tertiary times: unequivocal evidence of which is found in the facts that the very latest of these tertiary rocks have undergone extreme disturbance, and that tertiary rocks of marine origin are found at great elevation in the central Himalayas. It is in the elucidation of such apparent contradictions that the origin of the mountains is to be traced out. We have as yet only made a beginning in that direction, the ground is so difficult of access and so much of it is absolutely closed against observers; but it is already plain that the Himalayas were not made in a day or all at once.

Composition of the tertiary series.

The sub-Himalayan series is of enormous thickness, aggregating from 15,000 to 20,000 feet; yet throughout it there is a remarkable sameness in the character of the deposits. The prevailing rock is a massive pepper-and-salt sandstone, exactly like the sub-Alpine tertiary rock known to Swiss geologists as molasse. In its freshest form at the top of series, when very little consolidated, it is undistinguishable from the sand deposited in the beds of the great Himalayan rivers. In the lower part of the series it has become a very firm rock, often of dark purplish colour. With the sandstone there are locally associated strong beds of clay. In the upper horizons, even when turned up vertically, these are undistinguishable from the brown clays of the plains deposits; while the lower beds assume generally deep red tints. Besides the sandstones and clays there are locally enormous accumulations of conglomerates; they always prevail at the top of the local sections, but whether these separate bands are, or not, all of the same age is one of the many crucial questions that remain to be answered.

Derivation from Himalayan ground.

It is through these conglomerates, the materials of which can be specifically recognised, that the most distinct evidence is afforded of the local derivation of these deposits. In the neighbourhood of the great Himalayan torrents the upper tertiary conglomerates are in prodigious force, and are made up of large boulders and pebbles, precisely such as now occur in the beds of these torrents as they issue from the mountains; whereas in the intervening ground between the great rivers the corresponding beds are often largely made up of clays, and such conglomerates as do occur are formed of *debris* of the adjoining ridges, sometimes of the older tertiary sandstones. It is thus plain that at that time the boundary of the mountains was approximately the same as now, and that their features have not been seriously disturbed by the forces which have turned up on end such vast masses of the later tertiary strata.

The first thing to be done is to classify these rocks. This process will indeed reveal nearly all we know about them, for in geological classification composition counts for little, the structural conditions, involving relations of age, being all-important. The beginning of a classification was made many years ago by independent observers: Major Vicary found some fossils at Subáthú which were determined to be of nummulitic (eocene) age; and the early engineers (Baker, Durand, Cautley) of the Jumna canals brought to light the upper tertiary fossils of the outer hills. A magnificent collection of vertebrate remains was made by Colonel Cautley, and in great part described by Dr. Falconer; and since then the name Siwálik has been famous in geological annals as denoting a richly fossiliferous group of tertiary rocks at the base of the Himalaya. None of these explorers made any observation worth mentioning on the structural features of the rocks, so all the geological work proper remained to be done, though of course it was a great advantage to begin the investigation with two well determined horizons.

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Original discovery of lower and upper tertiary groups.

Any attentive reader who knows these hills will have met with a check in the last paragraph, at the mention of tertiary rocks at Subáthú, knowing as he should that this hill station is not orographically in the sub-Himalayan zone. This departure from the normal state of things as previously sketched is one of the great advantages already alluded to as peculiar to this Simla area owing to its partially terminal position in the Himalayan system. Not only are the principal rocks of the lower Himalayan less disturbed and less altered, and therefore under better conditions for observation, here than anywhere to the east; but we also find here, between the Jumna and the Sutlej, the only remnant of lower tertiary strata as yet observed in the lower Himalayan region, with the exception of one small outlier on the ridge east of Rikikes where the Ganges debouches from the mountains. Within the sub-Himalayan zone proper east of the Sutlej the lower tertiary (nummulitic) beds have nowhere been found, much less the actual base of the series; so that but for this remnant on the border of the Simla area we should know nothing of the original relations of the tertiary series to the older rocks of the mountains, and such a gap in Himalayan history would have been irreparable.

Tertiary outlier in lower Himalayan region.

By "original relations" we of course understand the condition of the older rocks when the next deposits began to be formed, and to explain this it is necessary to have some acquaintance with the former. The newest rock of the older formations in the Simla area is the Krol limestone, forming the picturesque mountains on three sides of the Solan rest-house on the Simla road. Below the limestone there is an immense but unknown thickness of strata, in which shaly flaggy slates form the prevailing type. All these stratified rocks are now greatly crumpled up and deeply eroded, but it is certain that formerly they were quite flat and that the limestone extended indefinitely beyond the limits to which it is now reduced. The age of the Krol limestone has not been fixed, for want of fossils; but the latest age assigned for it is the triassic, the lowest system of the secondary era. This would make a great break in the sequence

Original relations.

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Steep abrupt junctions.

between it and the lowest tertiary strata; but this fact is quite evident independently.

The commonest mode of junction between the tertiaries and the old rocks is one of abrupt abutting contact. Thus in the narrow ridge crossed on the Simla road between Dharampur and Solan the south face is of tertiary sandstone and the north face of the Simla slates. Had the formation of stratified rocks started upon an even bottom and gone on uninterruptedly, such a junction as this could only take place by "faulting," *i.e.*, a fracture on either side of which upward or downward movement took place, bringing beds of different ages into juxtaposition. There is a natural proclivity in observers to interpret such junctions from that partially normal point of view; but it is plain that any natural basin of deposition formed by the depression of a land surface must present many steep slopes and scarps along which the new deposits would originally abut against the old. Any one with the smallest geological discernment must perceive the very different significance of these two modes of junction, so similar in outward appearance. The worst of it is that the distinction of them in the field is most difficult, on account of the rarity of finding a contact section well exposed; and even when such a natural section is found a conclusive criterion may be wanting. Very commonly the appearances would be deceptive, especially in rocks that had undergone subsequent compression, as is so markedly the case here; for a surface of contact between rocks of very dissimilar texture would be a locus of crushing and of friction or even of faulting, whereby the original character of the junction would be completely disguised and reversed. This technical point has been explained at some length, because the interpretation of boundaries is of paramount importance in geology, and prominently so in cases of mountain structure, as will be illustrated further on.

Crucial section at Subáthú: pre-tertiary Himalayan elevation.

Some few basal junctions of the tertiary series have been described, an important one being at Subáthú itself, which stands partly on nummulitic rocks and partly on the slates. Between the bazar and the parade ground there is a steep synclinal fold of the strata, a characteristic ferruginous bottom bed of the tertiary series cropping up on both sides and quite parallel with the bedding of the underlying slates. Down the steep valley to the north-west the flexure can be traced continuously, the same beds being in contact throughout. Two very important inferences may be drawn from this section. First, that the old rocks must have been deeply denuded, probably as a land surface, before the nummulitic period. The total absence (so far as known) of intermediate formations between trias and tertiary in the outer Himalaya would in itself suggest such a fact, unless we were to presume that all had been subsequently removed; but this Subáthú section *proves* that for an indefinite pre-tertiary time this portion at least of the lower Himalaya had been undergoing denudation. The precise horizon of the slates at the contact has not been made out, but more or less of these strata and all the Krol limestone had been removed. An extensive pre-tertiary Himalayan elevation is thus established for this portion of the ground.

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Did not involve contortion here.

The second point established by the Subáthú section is equally important as regards the mode of that disturbance. When the nummulitic deposits took place at Subáthú the old slates there must still have been approximately horizontal, for the strata of both formations coincide. It is thus shown that little or none of the special disturbance now characterising the Himalayan region had then taken effect in this position, so that the previous elevation of this area must have been of the kind known as "continental." For the study of the difficult question of mountain formation, such points as this are of great importance; where evidence is so complicated and obscure, and inferences are accordingly more or less conjectural, any fixed point in the enquiry is very precious.

Probable original limit of basin.

The older tertiary strata here seem never to have got level with the top of the Krol limestone, which probably formed scarped plateau islands in the nummulitic sea or estuary. The conditions would further suggest that for the lowest tertiary rocks, as already shown for the upper part of the series, the northern limit of deposition was not far from the present north boundary. The whole tertiary outlier on the edge of the outer Himalaya, like the small section at Subáthú, is supported on the older rocks, which can be seen beneath the nummulitic beds at many points along the outer boundary. To the north-west, at the Sutlej, the outlier passes into a zone that must appropriately be considered as fully belonging to the sub-Himalayan region, and in which the lower beds become rapidly depressed out of sight; while to the south-east, before reaching the Jumna, it becomes extinct by denudation along a ridge, thus directly illustrating the general easterly increase of the elevatory action in early tertiary time.

Subáthú, Dagshai, and Kasauli groups: Sirmur series.

Only marine nummulitic deposits have so far been mentioned in connection with the lower tertiaries of Subáthú, and these lowest beds are known as the Subáthú group; the prevailing rock is a crumbling yellowish brown clay with some bands of earthy limestone in which the fossils are principally found. The thickness is very variable owing to inequalities in the floor of deposition: in the little section already described at Subáthú there may not be more than 100 feet of the bottom beds, while in the deep valley to the south, and elsewhere, the group must be nearly 1,000 feet thick. It passes upwards transitionally, by interstratification, into rocks of the normal sub-Himalayan type, thick red clays and strong gray and purplish sandstone; these are well exposed in the Dagshai hill, and this name has been adopted for this portion of the series. In the highest beds sandstone almost exclusively prevails, as in the ridge at Kasauli, which name has been given to this upper division. In a fine greenish shaly band at Kasauli numerous fossil leaves have been found indicating the proximity of a sub-tropical forest. The thickness of these upper freshwater deposits may be about 1,500 feet. Thus the rocks of lower tertiary outlier form a closely connected and complete little series to which the local name Sirmur has been given for convenience of distinction, from the Native State in which a large portion of the outlier occurs. Within the series a most complete change takes place in the facies of the deposits, from exclusively muddy beds with marine fossils into a

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Subáthú, Dagshai, and Kasauli groups: Sirmur series.

prevailing sandstone formation in which the only remains are terrestrial. The change took place most gradually, apparently by the filling up of an estuarine basin and the consequent exclusion of marine by fluviatile deposits; the latter being of the type that henceforth obtained exclusively throughout the sub-Himalayan period. Fossils are very scarce, and without them any more precise sub-division of the series would be impracticable; but no doubt it represents a long lapse of time, during which the growth of the Himalaya had steadily progressed.

Middle tertiary; Náhan group.

Having now got some idea of this Sirmur series at the base of the tertiary system, and of the Siwáliks at its upper limit, we may endeavour to fill the gap between them; even a partial equivalence of those two has never been suggested, but such a relation in part has been maintained for each with reference to an intermediate group of rocks. In the far north-west generally, and even in Kángra locally, there is apparently continuous transitional sequence throughout the whole tertiary system, and any divisions to be attempted there can only be of the approximate kind already indicated in the Sirmur series; but east of the Sutlej along the whole lower Himalayan border there is a sharp abutting boundary (wherever the contact has been observed) between the Siwáliks proper and an inner band of more or less similar rocks lying at the very foot of the mountains, the two being generally separated by the longitudinal valleys known as *dúns*. The town of Náhan, the capital of Sirmur, stands on this inner zone, and it is convenient to designate it by this name; it consists of moderately hard thick sandstones and red clays. On the inner side the Náhan group is in abutting contact with the slates, along what may be conveniently referred to as the "main boundary," being that at which a total and permanent change of rocks takes place throughout the whole outer Himalayan border; only in the Simla area do the Náhan beds come into juxtaposition with the Sirmurs at this boundary, and the discussion of their relative ages is a very close one.

The Náhan-Siwálik boundary.

For both the Náhan boundaries the doubt lies in the difficulty indicated in a previous paragraph regarding the interpretation of steep abutting junctions, whether or how far they are original or induced by faulting. It was for a time thought that a certain section of the Náhan-Siwálik boundary gave positive proof of its being an original contact by the interlocking of projecting portions of the two formations in a manner incompatible with a faulted junction, and such as would naturally occur if the newer strata had been deposited against an unevenly worn cliff of the older; but the observation was erroneous, and the question is still an open one. If the feature be due to faulting, the "throw" must be of several thousand feet, for the horizons in contact are topmost Siwálik conglomerates and lowest Náhan beds. In such ground this might not be objected to, but there are other facts against the view of simple faulting: the run of the boundary is sharply irregular, and this is scarcely compatible with a fault of such magnitude; but chiefly, the Siwálik conglomerate here is largely made up of boulders of Náhan (or Sirmur) sandstone, which suggests or requires that when the conglomerate was laid down the relative position of the

older sandstone must have been more or less what it is now. No distinct identification of beds in the Náhans and Siwáliks on opposite sides of the boundary, as implied by faulting, has been made, but it is not denied that such may be possible.

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The Náhan-Sirmur boundary.

In the case of the Náhan-Sirmur (main) boundary, faulting to a great extent has probably occurred, yet it is still doubtful whether any part of the Náhan group corresponds with any part of the Sirmur series on opposite sides of the line. On the strength of an admitted general resemblance it has been asserted that the Dagshai and Náhan groups are equivalent, but there are great difficulties in accepting this view. The thickness of strata exposed in various sections of the Náhan zone is greater than the Dagshai group exhibits anywhere in the Sirmur area, yet nowhere have the Subáthú beds been detected outside the main boundary, although they are so freely exposed in the adjoining area inside it. The only possible representative of the Kasauli beds would be the top Náhan sandstone, for clays become more and more abundant low down in the section; yet at the lowest points no signs of the easily-distinguished nummulitic clays have been detected in the many sections that have been explored. The correspondence of the Sirmur and Náhan formations can only be maintained on the supposition that the deposits thickened very rapidly to the south, and that thus the nummulitic beds have been permanently depressed out of sight on the downthrow side of the fault; but until the matter has been more thoroughly investigated it is well to keep the two in view under distinct names. In any case a name would be required to denote the inner zone of middle or lower tertiary rocks, so well defined structurally and so persistent throughout the sub-Himalayan region from the Simla area eastwards, and as typically displayed in the Náhan section.

Difficulty as to fossils.

It may have been remarked with surprise that in this tentative discussion upon the classification of the sub-Himalayan tertiary rocks so little mention has been made of fossils, which are generally understood to be the certain indicators of stratigraphical horizons. The truth of this rule in a very important degree has been already exhibited in the initial determination on no other grounds of two horizons in this great series of deposits, the lower tertiary marine nummulitic beds at the base and the upper tertiary mammalian land fauna at top. But for detailed classification this important branch of geological evidence is in a great degree dependent, and in a new region must always remain so, upon the stratigraphical observations by which the palæontological rule was first established. When once the original order of sequence of the strata has been clearly made out in any one section of a new field, however large, and the distribution of organic remains in that sequence made known, a single fossil from a distant outcrop will often decide with great precision the position of that outcrop in the local series; but the preliminary stratigraphical diagnosis cannot be dispensed with. In many geological regions this is comparatively plain sailing: we have however already seen something of the difficulties that beset it in a mountain region, especially in those deposits whose growth was contemporary with that of the mountains themselves, whereby

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Difficulty as to fossils.

they were subjected to chronic disturbance producing stratigraphical anomalies that never occur under normal conditions of deposition, such as complete conformity and utter discordance within a small group of strata at a very short distance. In ground of this kind fossils would indeed be of direct and immediate aid, where crucial sections are so rarely exposed, as in such a case of discordance, if the same or very closely allied fossils were to be found in the beds thus discordant, the anomalous physical relation would be at once betrayed. Similarly, on a large scale, the detection of the same fossils at distant points in a section would give a safe presumption of corresponding horizons: it is for the due co-ordination of different fossils that a prior stratigraphical study is needed.

Lost vertebrate fossils of Subáthú and Náhan.

Owing to difficulties and mishaps our knowledge is still very unsatisfactory regarding the distribution of fossils in the sub-Himalayan rocks. The great mass of them contain only terrestrial and freshwater fossils, and these are by nature peculiarly capricious in their occurrence. Major Vicary mentions having found bones in the clay on which the Quarter-guard at Subáthú stands, but they were never described and have been lost sight of. That was more than thirty years ago; and it is grievous to think how many thousands of British soldiers have since then spent the season at Subáthú, sadly in want of something to do, and to some of whom at least the search for fossils would have been a pleasant pastime, yet nothing of the kind has been thought of. A similar misfortune happened to some teeth and other mammalian remains found by Colonel Cautley at Náhan, which he identified conjecturally with those he had found in a similar clay at the base of the Siwálik hills east of the Jumna at the mouth of the Kálawála pass. This was just the sort of observation that is so much needed as affording an identification of horizons on opposite sides of the disputed boundary. On account of this, and as several experienced observers had subsequently searched in vain for fossils about Náhan, special reference was made to Sir Proby Cautley on the subject, and he very positively confirmed his statement that he had found the fossils "on the north side of the town of Náhan." All Colonel Cautley's magnificent collections were sent to the British Museum. Dr. Falconer's description of them in the "Fauna Antiqua Sivalensis" was protracted over many years and never completed. In this work the large showy specimens from the outer and newer rocks claimed first attention, so that the smaller things, often of greater interest to the geologist, dropped out of sight, and cannot now be found. Other instances might be given of invaluable specimens being lost for any real use through the mistaken zeal of private collectors, hoarding as curiosities what might in proper hands be important contributions to knowledge. Whatever excuse there may have been in past years for this wasteful practice, there can be none now that a properly-appointed Museum is established in India.

Original confusion of horizons.

All the materials of the "Fauna Antiqua Sivalensis" were obtained in the Punjab, in the outer hills between the Jumna and the Sutlej; for it does not appear that any fossils of the considerable but very local find at the Kálawála pass were ever specifically

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Original confusion of horizons.

determined. A provisional list of them is given by Colonel Cautley in his Memoir in the Geological Transactions, 2nd series, Vol. V, and quoted in Falconer's Palæontological Memoirs, Vol. I, page 35. Although the original Siwálik range is that east of the Jumna, outside the Dehra Dún, no fossils are recorded from it except those (just mentioned as having been lost) from the bottom clays at the mouth of the Kálawála pass; yet the west Jumna continuation of what is now taken as geologically the same range was the ground most prolific of fossils. A brief notice of this puzzle will illustrate the problems that occur throughout this region. The west Jumna continuation of the Siwálik range is not strictly in line with that east of the river, being partly in *echelon* to the south; and the rocks are on the whole very different; coarse conglomerate and sandstone are almost the only rocks in the eastern ridge, while in the western hills clays abound. For all these reasons, and because of the provisional identification of the Náhan and the Kálawála fossils, Colonel Cautley and his colleagues never supposed the rocks of the hills on opposite sides of the river to be on the same horizon. He had taken no account of the break in the sequence at the abrupt junction south of Náhan; that striking feature, which cannot but have been seen, seems to have escaped notice altogether, and the section to have been taken as an ascending one throughout, thus making the Náhan beds newer than those of the outer hills. Accordingly Colonel Cautley accounted for the absence of the fossiliferous beds east of the Jumna by their non-upheaval in that direction.

Probable explanation.

Although this view of the relative ages of the two zones cannot for a moment be entertained, the supposition of the east Jumna Siwáliks belonging to the Náhan group, and being quite distinct from the west Jumna Siwáliks, might plausibly be maintained; and it would at once remove the apparent difficulty of the contrast in composition between the adjoining portions of the same range. There are cross-faults and dips in the dividing gorge of the Jumna that would easily lend themselves to such an interpretation. Accepting the identification of the top beds at Náhan with the bottom beds of the Kálawála pass, we should then only have to say that all the overlying strata of the eastern section had been removed at Náhan, and that all the underlying beds of Náhan are still below the ground on the south side of the eastern Siwálik range. But this is not really the simplest view to take; and by the law of parsimony we are bound to take the simplest view until a clearly better one is offered. There is a manifest explanation of that primary difficulty of the contrast between the rocks to west and east of the Jumna under the supposition of their being contemporaneous. The gorge of this river through the Siwáliks is a long way to the west of its debouch from the mountains near Kálsi; so it seems that when the Siwálik upheaval set in the river found the easiest course to be to pass completely round the great banks of conglomerate it had accumulated in front of its mountain gorge. This would fully explain its present position in the Siwálik range between contemporary beds of very different deposits; and it is quite

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Probable explanation.

intelligible that mammalian remains should not occur in coarse "fan" accumulations, and yet be common enough in tranquil inundation deposits close by. The cross-faults and dips now found in the gorge would naturally occur between masses so differently made up. It is usual in such cases to assign the fault as the inducing cause of the river gorge, but in this case the opposite is more likely; it is quite certain the river was thereabouts before the cracks were started; and it is quite probable that the initial erosion of the gorge helped to determine the position of the fractures. We may still provisionally accept Colonel Cautleys' unauthoritative identification of Náhan beds with bottom Siwálik beds, and so consider the former group as in part lower Siwálik. It would be impossible at present to attempt any closer correlation.

Change of the leading structural features.

The change that occurs in the sub-Himalayan zone west of the Simla area, in connection with the suppression of the lower Himalayan region, may be best illustrated by showing what becomes of the two leading structural features which we have seen to characterise that zone on the south margin of the Simla area. The Náhan-Siwálik and the Náhan-Sirmur boundaries, the latter being the "main boundary" of the tertiaries with the old rocks, are continuous throughout the whole region to the east, and almost constantly present the same structural characters, the newer rocks dipping steeply towards and apparently passing under the older. To the west, before reaching the Sutlej, the Náhan-Siwálik boundary, or at least the feature which is apparently continuous with it, declares itself as a faulted anticlinal flexure with steep divergent dips. Within a few miles beyond the deep gorge of the Sutlej above Bubhor this fault and the steep ridge along it die out, and the upper conglomerate beds sweep round the termination of the anticlinal into the valley on the north of the Bubhor ridge, the core of which is formed of lower Náhan beds. This particular ridge and outcrop of Náhan rocks thus becomes wholly extinct shortly after entering the Kángra district. Something very similar occurs along the Náhan-Sirmur, or main boundary. Where it crosses the Sutlej, north of Bilaspur, its direction is nearly due north. Within five miles to the south, east of Bilaspur, the limestone is at the boundary: then the Subáthú nummulitic beds take its place, and steadily higher beds appear along this inner side of the junction, until the feature becomes lost beneath newer tertiary beds which sweep across it into connection with the end of an anticlinal flexure in the Sirmur zone.

Leading structural features of the western area.

The change of direction which is so marked in the boundaries of the Sirmur zone and in the strike of the rocks within it, coinciding with the terminal edge of the lower Himalayan area, is not noticeable in the features of the newer tertiary area. The Náhan ridge above Bubhor at the Sutlej has very nearly the same north-westerly strike as the Siwálik range east of the Jumna. This divergence of the boundaries produces of course a great widening of the Náhan zone as so far described. At Nálagarh it is ten miles wide, formed chiefly of repeated complicated foldings of the deep red and purple clays and sandstone of the lower tertiary type.

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Leading structural features of the western area.

From this nexus of contorted strata originate the flexures which produce some principal features of the sub-Himalayan region to the west. The first great flexure passes down the valley of the Gambhar, and before reaching the Sutlej exhibits what may be called the normal structural feature of the sub-Himalayan region, a junction along which the newer strata appear to dip under the older. A second similar feature, a little to the south, originates in the Mangarh ridge on the left branch of the Sutlej. They both are evidently faulted flexures of apparently great "throw"; and thus bringing rocks of very different horizons in contact, they are geological boundary lines like those already described. In an important respect there is a marked difference between these otherwise similar boundaries: those described to the east exhibit frequent sharp changes of direction, whereas these two in the western area can be traced in remarkably straight lines or very flat curves across the Kángra district and through the Jammu hills into the Jhelum district; they are constantly connected with more or less steep ridges formed of the harder lower rocks on the up-throw side of the fault, always more or less steeply inclined. Away from the line of disturbance newer strata, generally conglomeratic, come in, and the dip flattens to the horizontal, forming *dúns* in the manner already described. There are three principal *dúns* thus formed in the Kángra district. It is here again noteworthy that, although the leading structural features of the sub-Himalayan zone are of the same type throughout, there is complete break of continuity between the actual lines along the lower Himalayan border and to the west of it, although in each area those lines are remarkably continuous.

The Sirmur zone between the Sutlej and Ravi.

It has been said that west of the Sutlej the Sirmur series, which in the Simla area is found on the south-western margin of the lower Himalayan region, comes down to form an inner zone of the sub-Himalayan region; and that henceforth to the west the "main boundary" is the inner boundary of the Sirmur zone. The depression, or even partial suppression, of this zone in the Kángra district, and especially in the neighbourhood of the Beas, is an interesting and still obscure point in early Himalayan history. This great torrent leaves the mountains close to the innermost angle where the termination of the lower Himalayan boundary bends into the strike of the main axis along the base of the Dháola Dhár ridge. The gradual introduction of higher beds along the outer boundary of the Sirmur zone (the old "main boundary") north of the Sutlej, and the final overlap of much newer conglomerates across the prolongation of that boundary, have already been noticed. A similar change takes place along the inner boundary (the new main boundary) and throughout the whole zone, which is here some twelve miles wide. The basal nummulitic group entirely disappears, and has not been again detected east of the Ravi; and in the section of the Beas the prevailing type of rock is more that of the Siwáliks than of the lower tertiaries. Near Sih, north of the salt mines, at Drang, the topmost beds next the boundary are fresh-looking conglomerates, dipping as usual towards and apparently

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The Sirmur zone between the Sutlej and Ravi.

under the old rocks. This is the most easterly appearance of a conglomerate in the Sirmur zone, and it shows at least that the change noticed here is not merely owing to a local defect of induration. A remarkable fact has been noticed regarding this conglomerate: the top beds contain much large angular *debris* of limestone and pink sandstone found in the adjoining ridge of old rocks; but the rock now most prominent in that ridge, and the *debris* of which is most abundant in the actual talus, is not represented in the conglomerate. It is a trappean rock; and the obvious suggestion is that its intrusion is of later date than the conglomerate, which is what we should expect if this rock is of Sirmur age. Passing on westwards a reverse change sets in, the rocks again presenting an older facies with greater induration and a corresponding increase in the general elevation of the ridges, which is a marked feature throughout the Sirmur zone. The sanitarium of Dharmsála is in this zone, close under the lofty Dháola Dhár at about its middle. South of Palampur a spur of the Sirmur rocks runs south-eastwards and looks like a reappearance of the old main boundary from beneath the overlapping newer tertiaries. Towards the Ravi the Sirmur band becomes very narrow, locally almost obliterated: a condition evidently connected with the extreme disturbance and compression to which it has been subjected in this position. At the end of the Dháola Dhár, west of Dalhousie, the rocks are so crushed up with the slates that the boundary becomes very obscure, and the rocks scarcely identifiable. Fortunately in this very place some plant fossils were found identical with those in the Kasauli beds. It seems impossible not to connect the condition of these rocks here with the extrusion of the gneissose granite of Dalhousie.

The question to be solved.

The question to be worked out in the Kángra district and throughout the region to the west is, how far these successive sections of similar rocks are repititions of the same series. From each of the fault boundaries that traverse the area from end to end we find an ascending series from deep red clays and strongly indurated dark sandstones through gradually paler and softer strata ending in coarse conglomerates. If we could take these boundaries as simple faults, of later date than the newer beds at the contact, and all more or less synchronous, the equivalence of the several bands of similar rocks might be assumed; but the probability is rather that these dislocations were not synchronous, that each took ages to produce, and that deposition was going on all the time. Nothing short of extensive dissection of the ground would make it possible to unravel the stratigraphical complications resulting from such conditions; so the solution must in a great measure rest upon fossil evidence, and this is very scanty. In the two outer ranges some fossils have been found, but not one as yet has been recorded from the inner half of the tertiary area in the Kángra district. As this is the very ground that has been so much taken up by English settlers, we would impress upon them the very great interest that attaches to any find they may make of organic remains, and the importance of noting the position in which they occur.

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The tertiary zone in Jammu.

The town of Jammu stands on the outermost fringe of the Siwálik hills, and the condition of the upper tertiaries in this area is only a continuation of that in Kángra. If however we may take the Jammu hills to mean the tertiary rocks outside the Pír Panjál range between the Ravi and the Jhelum, something has to be said regarding the Sirmur zone. It repeats in a partially reversed way the conditions described in the Simla area. There the lower tertiary series occurred as an outlier among the older rocks, while in Jammu the older rocks occur extensively as inliers in the Sirmur zone. At the Ravi the zone is only a few yards wide, but it expands steadily westwards with increased elevation of the rocks. At the Pine river, 16 miles from the Ravi, the Subáthú nummulitics appear along the outer boundary. At the Táwa, 50 miles from the Ravi, the band is 18 miles wide. Not far to the west, on the Chenab, there are two extensive inliers of massive limestone: the largest occurs at the outer boundary, forming a lofty ridge some 30 miles long, through the very centre of which the Chenab flows by an impassable gorge just above the town of Riassi. This limestone is more massive than that of the Simla area. No fossils have been found in it, and it is only conjecturally correlated with the Krol limestone. These inliers are not, however, like those of the Krol limestone, masses isolated by denudation around which the nummulitic deposits had been laid down; they are altogether the result of later upheaval, for the nummulitics are found on the highest summits of the limestone, and everywhere, as in the Simla area, the bedding in the two formations is conformable notwithstanding their prodigious difference in age. It would thus seem that the pre-tertiary elevation and denudation so well marked in the Simla area had been less effective here. Some important modifications are noticeable in the Subáthú group, the beginning of the conditions that prevail in the extra-Himalayan region to the west. The same pisolitic ferruginous bottom bed occurs here too; but there is a greater concentration of the limestone near the base, and below it we find a carbonaceous band that is not represented in the Simla area, but is the same that has so often raised and disappointed hopes in the Salt Range, the Chitapahár hills near Attock, and all down the flanks of the Sulemáns into Sind. This "coal" is nowhere more developed than on the western flanks of the Riassi inlier; and it is again well seen about the similar inliers on the Púnch river, as at Dandli. As we found the lowest beds of the zone along the outer boundary, so the highest are found at the inner (main) boundary. On the upper Táwi, west of the Bindí gap, strong conglomerates are found nearly vertical next the old rocks, and the puzzle is that they are largely made up of coarse subangular *debris* of tertiary sandstone. This is an opposite difficulty to that noticed in the homologous position at Sih. Again, on a branch of the Táwi, north of Chineni, there is a considerable thickness of pale soft clays, more like Siwáliks than Sirmurs; a search in them for fossils might reveal something.

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SECTION F.—HIMALAYAN DISTRICT—THE MOUNTAIN REGIONS.

Incomplete as has been the study of the sub-Himalayan tertiary zone, the examination of the higher mountains is still less advanced, and only general indications of the structure can be given. Although the actual features do present three distinct regions, geological as well as orographical, namely, the lower Himalayan, the axial, and the trans-Himalayan or Tibetan regions, in a brief sketch like the present they must be treated connectedly.

Two main rock series.

Provisionally we may speak of two main series of rocks in the lower Himalaya—one of little altered rocks, and the other of mica-schists and gneiss. In the Simla area the former occupy a large portion of the lower Himalayan region on its outer side, while the metamorphics belong rather to the axial region. As we go eastwards the metamorphism increases more and more, so that on the Nepal and Sikkim border there is scarcely a remnant left of unaltered rocks. It is thus evident that the Simla area offers special advantages for observation.

The lower Himalayan series.

The least disturbed section of the lower Himalayan series is that on the main road to and beyond Simla. Immediately inside the tertiary rocks of the Sirmur outlier the road winds round two mountains of limestone, the Boj and the Krol. This limestone is certainly the newest (highest, youngest) of the old rock series on this section, and as yet no newer rock has been finally identified in this area, although the occurrence of such is by no means improbable, seeing the immense break in time between this limestone and the oldest tertiaries. By comparison with the sections in Spiti the Krol rock has been provisionally identified as triassic by Dr. Stoliczka and others who have seen both sections. The Krol limestone is quite unaltered, often earthy and with alternating shales, and at its base there is a variable band of sandstone. Below this group, to the lowest depths of the valleys, we find only shaly flaggy slates, with one important exception : at about 1,000 feet below the Krol sandstone there occurs a small but very well defined group, of wide distribution ; it consists of a clear pale gray, pink, or buff, dense magnesian limestone, overlying a quartzite sandstone which is very generally conglomeratic. The two together do not generally exceed 100 feet in thickness ; they are well exposed in several outcrops along the Blaini stream, which takes its rise west of the Solan rest-house, and hence the group has received the name Blaini. The beds between the Krol and the Blaini groups, classed as the infra-Krol shales, are often carbonaceous, so much so that coal-mining has been attempted in them ; but they are not otherwise very different from the beds below the Blaini group, generally referred to as the "Simla slates," which are often sufficiently indurated and fissile to be used for roofing, as at Simla, but are not true cleavage-slates. The provisional scale of groups is then as follows :—

Krol :—Limestone with shale ;
Sandstone.

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Infra-Krol :—Shales and flags, often carbonaceous.
Blaini :—Clear pale limestone;
Conglomeratic quartzite.
Simla slates :—Flags and shaly slates.

Want of fossils.

The want of fossils in the lower Himalayan rocks is one of the most disappointing and puzzling features in the geology of the region. All the rocks just mentioned are such as commonly abound in fossils, yet numerous expert geologists have searched these rocks in vain, with one obscure exception; globular and other concretionary shapes in the limestone have frequently been mistaken for fossils, but one small find of undoubted organic remains was made in a band of limestone low down in the gorge of the Bheng (or Tál), a stream east of the Ganges in the eastern Dún; they were casts of bivalve shells, but too imperfect for identification. The contrast in this respect with what are supposed to be equivalent rocks on the north of the granitic axis is remarkable, and on that supposition almost precludes the possibility of the basins of deposition having been originally continuous. A connection has thus been suggested between the lower Himalayan series and the great Vindhyan series of lifeless rocks of peninsular India, although there is little or no lithological resemblance between the two: from this point of view it is said that the crystalline rocks of the Himalayan axis may have then formed the north limit of the Indian continental region, and the lower Himalayan area a land-locked basin, and so, for some occult reason, without living beings. Another explanation lies in the correlation of these beds with much older slaty strata of the Tibetan region, which are there also comparatively barren in organic remains. This is superficially the simplest view; but any decision in the matter would be premature from present knowledge.

Distribution of the Krol rocks.

Where such intense disturbance has taken place the distribution of the rocks is necessarily very intricate. The limestone on the Krol is isolated as a capping; but from Kanog hill on the east it stretches in a more or less continuous ridge to the Tons, and on both sides of this valley it is found a long way northwards. West of the Krol there is an interruption in the usual fringing ridge of limestone. On the old road to Simla passing under Subáthú it does not appear, but it comes in again at Arki and continues thence northwestwards with very local interruptions, even in the narrow zone between the gneiss and the tertiaries along the flank of the Dhuladhár. For reasons explained in a former section it is natural that this highest rock of the series should occur most constantly in the position of least elevation on the margin of the region; and we may in an analogous way explain its frequent appearance in transverse areas of depression, coinciding with the great river basins. Thus it stretches far up the valleys of the Beas and the Sutlej which are separated by the lofty Jalori ridge of gneissic rocks. In these positions it often occurs at the lowest levels and reaches up to the summits of the adjoining ridges. The Shali mountain which forms such a picturesque object in the view to the north-east from Simla is a peak of this limestone, rising precipitously from the bed of the Sutlej.

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Section at Simla.

The centre of the Simla area, between the basins of the Sutlej and Tons, is principally formed of the Simla slates; and at Simla itself there is a remnant of the Krol group. The ridge is formed of the northern arm of a local synclinal, and there are several typical exposures of the Blaini group along the northern and eastern sides, at the lower limits of the station. The overlying beds are those of the infra-Krol group, the carbonaceous character being well exhibited at many points on the north side of Jako; the Boileauganj quartzites represent the Krol sandstone; and at Jatogh there is a remnant of the limestone. On the southern side of the synclinal the quartzites form the Tára Devi mountain. The culminating point of this area, and the most conspicuous feature in all this part of the region, is the Chor mountain to the south-east of Simla, rising to an elevation of 11,982 feet. It is of crystalline rock, but is an inlier (surrounded by the Simla slates), and not, like the Jalori ridge, a spur from the axial range. The nature of this rock will be discussed presently.

Trap rocks.

The distribution of the basic igneous rocks in this region is very noteworthy, in their almost exclusive preponderance in the areas of relative depression already noticed. In the section through Simla only one small vein of trap has been detected, near Narkanda; whereas in the adjoining valley of the Sutlej and again in that of the Beas strong irruptive dykes are frequent. It is pretty certain that these intrusions were of middle or late tertiary age. A suggestion to this effect was noticed in the absence of trappean *debris* in the Sirmur conglomerate at Sili, although trap is now conspicuous among the rocks from which the materials of that conglomerate must have been derived. Conclusive evidence has however been reported in the very local intrusion of this trap into the middle tertiary sandstone along the main boundary at the Giri. That such intrusions in the older tertiary rocks should be so exceedingly rare seems, under the circumstances, rather unaccountable; the massiveness and comparative softness of these rocks and their consequent indisposition to fissuring may explain the fact.

Relation of the slate and gneissic series doubtful.

The relation of the lower Himalayan series to the gneissic series is a crucial question in Himalayan history, and one upon which the evidence is still very obscure, or even conflicting. We have, for instance, already entertained two suggestions that are seemingly incompatible in this respect. The notion that during the Krol period there was already a gneissic barrier in the position of the present axis has been put forward to account for the non-appearance of fossils to the south; and some direct local observations seem to confirm this view. In some sections north-east of Simla the Krol group has been described as overlapping the Simla slates and resting upon the flanks of the gneissic range as if in original junction, the actual contact features being only obliterated by subsequent metamorphism. Elsewhere, on the contrary, and at no great distance, as in the Sutlej valley along the south base of the Jalori ridge, the whole Krol group seems to plunge steeply beneath the gneiss. On the other hand, we have seen that the bottom tertiaries were deposited on the uncontorted slates; and it is difficult not to connect that contortion with

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the formation of the principal stratigraphical feature of the mountains, the axis to which all these flexures are related. It is true that as a pre-existing ridge its influence under general pressure in determining the direction of secondary axes would have been very similar—we have already attributed the directions of the extra peninsular mountain systems to the form of the older continental mass—and along the fringe of the lower Himalayan region, at a distance from the axial rocks, where we have already shown the great flexures of the later tertiary deposits to have been produced since the adjoining mountains had assumed their present shape, it seems most reasonable to extend a like relation to the slate rocks and the axials. It is where the extreme terms of the series occur in close proximity that the question comes to a crisis: standing on the contorted eocene rocks at the base of the Dháola Dhár, within rifle range of the gneiss forming that precipitous ridge, it seems impossible to imagine that this can have presented anything like its present condition when the eocene rocks were laid down; and the Dháola Dhár, as we have seen, is an exact representative and an actual prolongation of the main Himalayan axis.

Relation of the slate and gneissic series doubtful.

In description of mountains the word "axis" is of frequent recurrence, and as it may be used in different senses it is well to be able to distinguish these. For the geographer, who deals only with superficial features, the definition would seem simple enough—the chain of loftiest summits determining the axis of the range. In a simple range this presents no difficulty; but in a great complex mountain system, such as we have here to deal with, some safer guide than mere elevation and position is needed, and geology offers the best standard of reference, there being a very close connexion between superficial features and the rock structure. For instance, very lately an official geographer in England has contended that some of the trans-Indus peaks are properly referable to the Himalayan chain. Now this chain, as above defined, coincides with a great stratigraphical axis; a line of granitic intrusion and of maximum upheaval, along which the oldest rocks attain their greatest elevation. As thus most clearly defined, the Himalayan range and axis completely die out within the Kashmir border, and the trans-Indus peaks aforesaid are geologically connected with the great gneissic range of Baltistan. If in geographical portraiture predominance be given to hydrographical basins and their watersheds, the range or axis would be defined by the line of highest gaps instead of highest summits; and under this definition the principal Himalayan axis would be locally placed some 20 miles north of that just indicated, quite away from the geological axis, on a secondary range produced entirely by denudation from the variously yielding outcrops of the sedimentary series on the flank of the gneissic or granitic axis. But some of the principal rivers (as the Sutlej) pass through this range also and drain large areas to the north of it, so it is plain that any regular correspondence between mountain chains and watersheds is out of the question. We have however in the great snowy range, to which the name Himalaya particularly belongs, an excellent example of a mountain chain coinciding with a geological axis.

What is the axis of the Himalayas?

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The interpretation of watersheds.

Although we have discarded watersheds as forming any criterion in the delineation of mountain ranges and axes, most interesting questions are suggested and sometimes solved by the study of drainage lines. The apparent anomalies presented are often very striking. It is quite common to see a river pass from low ground through a precipitous gorge in a ridge or spur of hard rocks where at a short distance on either side a channel might be formed over flat ground but little higher than its bed, as would inevitably take place if the gorge were dammed ; or we may find a river rising in comparatively low hills, and flowing right through a higher independent range. The easy assumption by which such features have been explained is that there was a natural fissure in the ridge or range. In some instances this may hold good, but certainly not in most cases ; and the true explanation is really more simple. The second of the instances above mentioned, though the larger and apparently more anomalous, admits of the more easily apprehended explanation ; it is, that the river was on the ground before the elevation of the range, and that this process was so gradual that the river could erode its channel *pari passu* with the rise of the ground, as we have seen must have happened during the rise of the outer Siwálik ranges. In the first and more common case, where there is no evidence for the interference of ground movements, the action has to be reversed ; but the reasoning is no less rigorous, for we are working with the absolute fact that water cannot flow uphill. We must in such cases conclude that when the gorge was eroded the ground on the upstream side of the present ridge must have continuously been higher than the water level in the gorge ; that in fact the ridge did not then exist, but has been carved out *pari passu* with the erosion of the gorge, by the general disintegration and denudation of rocks more liable to decomposition than those forming the ridge. This relatively greater or smaller liability of different rocks to denudation by attrition or solution, and the various ways in which such rocks are exposed by the disturbance they have undergone, are the principal inducing influences in the formation of all the varied features of mountain sculpturing. Before scrutinizing the Himalayan features from this point of view, a few words are needed as to what would take place normally (*i.e.*, without the interference of disturbance) under such conditions. Suppose an elevation to take place, longer than broad, and with a more or less central axis or crest of maximum elevation (to both of which conditions there would be a natural tendency) : drainage would then take place from that crest by the most direct fall. The original cast of the principal valleys would thus be almost wholly transverse to the axis, and would remain so for ever if the elevated mass were homogeneous. As this never occurs, a tendency sets in by which any river that has happened to erode more deeply than the others gradually draws off the drainage of its neighbours ; and so the main drainage, from being originally all transverse, becomes to a great extent longitudinal, *i.e.*, parallel to the axis. The process is very simple : the elevated mass is sure to be mostly made of stratified rocks of different composition and hardness ; these become tilted up in lines more or less parallel to the axis of elevation ; and as a

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matter of course the lateral drainage of the original transverse valleys begins to operate along the softer beds, leaving the harder ones sticking up as spurs; and thus at first any pair of lateral streams will start a watershed about half way between two main transverse valleys. If in either of these latter the cutting down of the channel proceeds more rapidly than in the other, the same must take place in its lateral stream, the watershed of which will thus be cut back until at last it will reach the adjoining transverse channel, and carry off its waters down the steeper course. In this way a whole chain of secondary streams may be connected into one principal longitudinal river, to which the head waters of the original primary transverse streams become affluents; and with each such accession the eroding power is increased and the process thereby extended. That such a process has operated is a well established fact; the lower gorges of the original transverse streams thus cut off remain as gaps in the ridge on the outside of the new longitudinal valley. There would of course be a corresponding tendency on the side of the more rapid drainage to cut back the primary watershed, but the chief factor in the process just described is the immensely greater facility of erosion along the strike of softer rocks; upon any harder rock in the original axis such erosion would be incredibly slow: and hence the corollary we have been seeking for—that within certain simple assumptions the initial axis of elevation would tend to be perpetuated as a main watershed.

An imaginary Himalayan axis.

Although we can by no means apply the simple assumptions aforesaid to the immense area of elevation of which the Himalayan chain forms a part, there may be some use in seeing what hints the drainage test may give. The main watershed between north and south is in the Mustag and Karakoram range, whence flow the northern affluents of the Indus, far to the north of what we must for the present call the Himalayan axis. This is of course a fact to be explained; but it is beyond our present scope, for it is certain that within this great area there were several axes of relative elevation and depression, whether synchronous or successive, and we are only concerned with the most southerly one. Of this we have already seen that the actual Himalayan chain coincides with a geological axis of maximum upheaval and of granitic intrusion, but it is quite possible that this may not be the axis we are in search of—the line of maximum effect due to the disturbance by which the contortion and elevation of the tertiary rocks was accomplished, which is perhaps what would be generally implied by "the Himalayan axis" from the geological point of view, for the Himalayan elevation is accepted as of tertiary date. The drainage test directly suggests such an idea, *viz.*, that the spill of the waters originated in a crest of greater elevation to the north of the actual mountain axis; and it is easy to indicate how such a crest may have been formed there, supposing the gneissic axis to have been in its place from very ancient times. A broad area to the north of this axis is occupied by an immense series of stratified rocks, ranging from unfossiliferous slates through palæozoic and secondary formations up to the cretaceous system. Now we know that the chief results

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of crust movements are proximately due to tangential pressures, which naturally take effect upon the most compressible materials, such as would be a mass of comparatively unconsolidated strata of variable composition. Under such a process the yielding mass would be squeezed downwards as well as upwards, so that the same axis might be stratigraphically one of both elevation and depression; and in fact we do commonly speak of this ground as a "basin," the newer rocks lying in a trough between two great protrusions of gneiss. It is in no way extravagant to suppose that a crest of maximum elevation may have been thus formed in tertiary times over this ground, from which originated the drainage crossing the older gneissic axis. Volcanic action may be largely called into play in support of this view, for there is a prodigious display of basic eruptive rocks connected with the newer sedimentary formations in Ladák and Hundes, where there may once have been a line of volcanic cones like those of the Andes. The subsequent greater erosion of that area would be due to the same cause as its elevation, the comparative softness of the rocks. If on the other hand the gneissic axis should prove to be of tertiary date, it would imply that the sedimentary series then reached across it, and that the Himalayan elevation was incomparably greatest on that line, where even now the oldest schists overlook the newer sedimentaries to the north. The watershed anomaly would then have to be explained as the natural result of the much greater steepness of the fall to the south, and also of the immensely greater rainfall on this side.

The granite.

We may now see what the gneissic axis has to say for itself. "Granitic axis" might be a more distinctive name for it, as there are in this region other gneissic axis that do not possess this character, the geological importance of which is immense although of uncertain interpretation. The rock was described as albite granite by Dr. Stoliczka (Memoirs, G. S., I., Vol. V), who was the first professional geologist to publish his observations on this ground; but Mr. Mallet has since shown that the felspar is oligoclase, not albite, by the analysis of specimens from the same locality, Wangtu bridge on the Sutlej. In the middle Himalaya, north of Kumaun, this rock takes a prominent part in the formation of the highest peaks; on the Sutlej it is also in great force, and it is still represented in the divided prolongations of the range by the gneiss of Zanskár and of the Dháola Dhár. This granite is undoubtedly the youngest rock in this axial range, and the function it performed (if any) in "the Himalayan elevation" is a very crucial question; Captain R. Strachey gave expression to a still prevailing opinion bearing on this point when he wrote (Quar. Jour., Geol. Soc., London, Vol. VII, 1851)—"The fact of the granite of the great snowy peaks being seen in veins, penetrating the schist up to 20,000 feet [on a previous page he mentions it as forming peaks 25,500 feet high], makes it highly probable that the granite must have been injected long before the mountains received any considerable development." Still this would not preclude its immediate connection with "the Himalayan elevation"; to ascertain this we have to determine the age of the granitic intrusion. Th

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only positive information we possess would place this event in a very remote age. Dr. Stoliczka quotes (*l. c.* p. 12) verbal information from General Strachey that the granite penetrates silurian and even secondary strata; but there may be some mistake here, for in the paper already quoted it is only described as penetrating the schists, and the opinion is clearly recorded—"That this granite is older than the silurian period is rendered probable by the comparatively unaltered state of the lower beds of the azoic slates at the foot of the palæozoic series, where almost in contact with it;" and General Strachey had not again visited the ground. He moreover gives it as his opinion that the gneissic range formed a barrier, though of course not with its present elevation, in palæozoic times. A confirmatory observation is recorded by Col. McMahon in the Spiti valley near Chango, where granite veins pervade the mica schists, but stop short at the contact of the overlying palæozoic slates and limestones. Still, these facts are not final; we have already seen how very rarely the eruptive traps of the lower Himalaya penetrate the tertiary rocks, although certainly of later date.

The gneissic rocks.

The crystalline stratified rocks forming the chief mass of the axial range are often spoken of as the gneissic series from their most conspicuous member, but on the whole there is perhaps a preponderance of non-felspathic quartz and mica-schists with some few hornblendic beds. These alternate with thinly bedded gneiss; but amongst them, and apparently interstratified, there is a very massive porphyritic granitoid gneiss to which special interest attaches. Dr. Stoliczka described this whole crystalline series under the title of "Central gneiss," considering it to be the principal geological axis of the Himalaya, and from an assumed homology with "the central gneiss of the Alps"—a comparison that is hardly borne out by structural evidence—but the name has more especially clung to the massive gneiss. It is from the stratified rocks that structural features can be made out, and from this point of view the gneissic axis does not present the symmetry that would be naturally associated with the word "central," and such as is often presented by axes of crystalline rocks, to or from which the rocks on either side have a prevailing dip. The strata of the gneissic axis offer no exception to the rule that prevails throughout the lower Himalaya as well as in the tertiary zone, that of a greatly prevailing northerly or inward dip. On its northern flanks these rocks are overlaid with rough conformity by the lowest slates at the southern outcrop of the sedimentary basin, while on the outer flanks we have seen the lower Himalayan rocks abutting against it in a very confused manner. Dips of course involve flexuring of the strata; and that any one dip should prevail over a large area requires that the flexures should be much steeper on one side than on the other, whereby the strata on that side would occupy less area, or even be broken and faulted out of sight. This absence of symmetry would imply a one-sidedness of conditions, contrary to what might be expected in a "central axis." It is of course possible that there might be no such central feature in a mountain system; but if one

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should occur it would seem to claim attention as probably of dominant significance in the development of the mountains. Now such a line is found in the "imaginary axis" mentioned in a former paragraph. The series of palæozoic and secondary strata to the north of this gneissic axis form a broad synclinal trough, on the north side of which in Rupshu crystalline schists and gneiss appear again in great force but with a steady southerly dip. Along this inner gneissic axis of Ladák we find moreover the significant fact that the palæozoic rocks have themselves undergone considerable metamorphism. These comparative considerations tend again to suggest that the Himalayan gneissic axis is of pre-Himalayan origin.

Granitoid gneiss or gneissose granite.

Very lately (1883) a new and most important interest has been conferred upon the massive granitoid gneiss that is so conspicuous amongst the rocks forming or adjoining the Himalayan axis. It appears that we must henceforth speak of it as "gneissose granite." No doubt the fact indicated by the change would be equally expressed by the term eruptive gneiss; and if the classification and nomenclature of rocks were to be altogether artificial and based upon researches in the cabinet, whereby foliation would be the one distinguishing character between gneiss and granite, the former name would have to be retained for this rock. If lithology had any *raison d'être* as an independent science such a method might be justified: but in reality lithology is quite a barren study unless as ancillary to geology, just as zoology is to biology. The natural classification of rocks can as little afford to ignore their functional characters as the natural classification of living things could dispense with physiological considerations and depend solely upon morphological characters. Now in geology the paramount signification of granite is that of eruption in a more or less plastic fused condition; and no less does the word gneiss imply that the form and association of the rocks are due to original deposition, whatever change of texture it may have undergone by molecular action, the foliation being due to original lamination or to cleavage. As an exceedingly general rule foliation is known to be a character of metamorphosed sedimentary rocks, and as a no less general rule the texture of granite is amorphous. It has however been observed that a viscous igneous rock under eruption may acquire by traction a streaked texture which would on crystallisation result in foliation, and it was long ago pointed out by Scrope that the gneissose texture might be simulated in this way; on the other hand it is conceivable that by extreme metamorphism a wholly amorphous crystalline texture might be locally produced in a bedded rock, without any disturbance of its normal structural relations. In these very exceptional cases, the true nature of the rock and the name it should receive can only be determined by close study on the ground, the terms "gneissose granite" and "granitoid gneiss" being for each case the natural expression of the result. Independent scientific observers have become so scarce of late in India that it is especially gratifying to be able to quote one of that brotherhood as the author of an important discovery, for so it deserves to be called. Colonel C. A. McMahon,

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formerly Deputy Commissioner of Simla and now Commissioner of Amritsar (which gives him the run of the Dháola Dhár), has been the first to bring the microscope to the study of Indian rocks; and it has led him to what is very nearly a demonstration that the granitoid gneiss of the Himalayan axis is truly an eruptive rock. Perhaps the best evidence in favour of this judgment is that it gave immediate relief to almost insurmountable stratigraphical difficulties. Where this rock appears amidst the gneissic schists of the great range there is little to suggest its being other than what it seems to be; continuous observation being very difficult in that region, only passing notes have been made along widely-separated sections. It is when this identical rock appears in more accessible ground, and in juxtaposition with little altered rocks, that as gneiss it has presented such difficulties of interpretation. The Chor mountain which has been mentioned as forming the most conspicuous feature in the Simla area is a typical case. The whole summit for several hundred feet is of this massive porphyritic granitoid rock, of exactly the same type as that in the main range; it is not only that it is characterised by the more or less distinct foliation and massive bedding, but its behaviour (*allure*) is very much that of a normally intercalated mass: it presents the usual steep southerly outcrop, while to the north it is overlaid at a moderate dip by schistose slates. It has however no continuity in strike, the area it occupies is as broad as it is long, with a diameter of about seven miles, and members of the lower Himalayan series appear close by on either side of it without extensive metamorphism. Still, in the absence of the usual positive signs of igneous intrusion, it was thought safest to accept it as belonging to the old gneiss, although very forced suppositions had to be made to account for its position, whether altogether by faulting, or partly as a mass already isolated when the Krol rocks were laid down.* A similar stratigraphical puzzle presented itself in the Dháola Dhár, where that range ends abruptly at the gorge of the Ravi, the gneissic mass, where it is still six miles wide, being truncated at right angles to its strike. Colonel McMahon has since observed that the granitic rock here is continuous, but reduced to a width of 250 feet along the northern edge of the outcrop, coinciding with an axis of flexure and of eruption, as is now maintained. When first describing the massive gneiss in the Simla region (Records, G. S. I., Vol. X, p. 222, 1877) Colonel McMahon remarked that "the internal structure of the rock is that which has usually been described as characteristic of an igneous rock." Subsequent and more leisurely study of the same rock and of its contact action on the schists in the Dháola Dhár at Dalhousie has led him to the conclusion that this pseudo-gneiss is truly an eruptive (intrusive) rock, and therefore to be called "gneissose granite" (Records, G. S. I., Vol. XVI, p. 143, 1883).

Granitoid gneiss or gneissose granite.

A conjecture is further hazarded that "instead of being an archæan, cambrian, or 'converted' silurian rock, it is in reality of

Age of gneissose granite.

* See Memoirs, G. S. I., Vol. III, Pt. 2, p. 46. It should not be forgotten that the observations referred to, from which our description is taken, were only cursory, during two traverses to north and south of the mountain.

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tertiary age and was brought into its present position in the course of the throes that gave birth to the Himalayas." It has been said before that nowhere is the relation of cause and effect between the Himalayan upheaval and the contortion of the lower tertiary strata so vividly suggested as along the Dháola Dhár, where very marked occurrences of both conditions are found close together; but this same juxtaposition renders it very difficult to accept this supposition in view of the eruptive character of the great mass of crystalline rock forming the ridge. It may be taken as certain that nothing like eruptive action in the full sense of the word took place here during tertiary times, for the full sedimentary series of that era in the immediate neighbourhood is entirely wanting in volcanic material. The character of this intrusion, so free from disrupting effects, would independently show that it must have been a deep-seated operation. We can then at least affirm that, if the eruption of this gneissose granite be of tertiary age, the entire mass now forming the Dháola Dhár, ranging above 16,000 feet in elevation, must then have been deep under ground. It is presumable that the same inference would have in some measure to be applied to the whole Himalayan axis: and the determination of age would apply *à fortiori* to the disruptive oligoclase granite, which must be newer than the gneissoid granite. Still neither this consideration nor those previously mentioned as bearing on this question would absolutely prohibit the suggestion of a tertiary age for this plutonic rocks, or of the existence of a very ancient ridge of archæan rocks in the position of the Himalayan axis. When this axis was spoken of as one of maximum upheaval, on the obvious ground that the oldest rocks are there found higher than the newest, aggregate upheaval was understood, which would not at all necessarily imply that the greatest elevation attained within this region had been on this axis. A gradual uprising along this line, including the whole lower Himalayan region, may have coincided with the slow depression of the sedimentary basin to the north; and the injection of the two granites may well have been delayed until the period of the greater movements which attended the Himalayan elevation proper. The extrusion of highly silicated plutonic rocks would naturally occur amongst the older rocks adjoining the principal focus of disturbance.

Peculiar metamorphism in the Simla region.

Certain abnormal circumstances of metamorphism, for which no satisfactory explanation is known, have frequently attracted notice at Simla. All the upper beds forming the summit and southern face of Jako, round which mountain a great part of the station is built, consist of thorough mica-schists with abundant quartz veining, while the base of the mountain is formed of slaty rocks exhibiting little or no crystalline metamorphism. Now there seems no question that all these rocks are in normal sequence, the altered beds being of the infra-Krol group, resting on the Blaini band and the Simla slates; so that the supposition of inversion is inadmissible. Similar conditions are found on Mahásu, the next ridge to the east-by-north. The feature is noticed here, as a sort of forlorn hope, in connexion with the extensive lateral intrusion of the

gneissose granite. This rock forms a nearly horizontal capping to the Hatu mountain, with what are taken to be lower Himalayan rocks close upon its flanks; but Hatu is 20 miles from Jako. The stratigraphical conditions required for the accomplishment of such a feat are too appalling to be contemplated; the suggestion is only made here to exhibit how much we have still to learn regarding the geology of the lower Himalayan region.

The trans-Himalayan region.

In crossing the Himalayan range we pass geologically no less than geographically out of India, from an anomalous country in which the standard stratigraphical tokens are almost wholly wanting, and where the geologist has to fall back upon first principles, into a land where he at once feels at home, the rocks being more or less amenable to an established code of evidence. Resting upon the northern flanks of the gneissic range there is a great thickness of slates in which silurian fossils have been detected, and they are overlaid in more or less normal sequence by upper palæozoic and mesozoic formations ending with the cretaceous. The general distribution of these sedimentary rocks presents a broad regularity that is most promising of results to future study. There is a principal division into two great longitudinal basins (in the stratigraphical sense), separated by the gneissic axis of Ladák; the northern basin lies between this axis and the crystalline range of the Kuenlon; the southern basin lies between the Ladák and the Himalayan gneissic axes. Regarding the former we have very little information. The best known section is near the western end in the Karakoram ridge, which seems to be a spur from the crystalline centre of the Mustag in northern Baltistan. The southern trough is partially known in what we may take as its western half, west of the middle Tibetan watershed near the Manasaraur lakes. At this point the sedimentary basin is partly interrupted by the crystalline mass of the Gurla mountain, which seems from General Strachey's map to be connected with the central gneissic range rather than with the Himalayan axis. At about 200 miles to the north-west the trough is again almost intercepted by the granitic or gneissic mass of the Purgúil mountain, the intermediate ground forming the plateau of Hundes, and the upper basin of the Sutlej. Here too the palæozoic rocks are continuous along the Himalayan side, south of Purguil, passing on into Spiti, where the whole sedimentary series again expands to form another elipsoidal basin about 200 miles long reaching nearly to Drás. This geological sub-region is best known as the Zanskár basin, as a very large proportion of the area is drained by the river of that name, a southern affluent of the Indus. The best known sections are in the basin of the Spiti river, an affluent of the Sutlej, but it only drains the south-east corner of the region. In the far north-west we find the palæozoic strata continuous across the termination of the attenuated representatives of the Himalayan gneissic axis; first by the Zoji pass into Kashmir, and thence along the Kishnganga valley to the south flanks of the Pír Panjál axis, whence there is a continuous outcrop into the lower Himalayan area. With patience and perseverance we may thus expect to establish a

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The Spiti section.

circuitous but connected identification of geological horizons between the rock series on opposite sides of the Himalayan axis.

The most complete known section of the trans-Himalayan rocks is that worked out by Dr. Stoliczka in the Zanskár basin, and principally in Spiti, through the abundant evidence of fossils (Memoirs, G. S. I., Vol. V, 1865). The following scale of formations has been there established :—

MESOZOIC.

(*n*) CHIKKIM SHALES (*cretaceous*).—Dark grey marly earthy shales ; 200 feet.

(*m*) CHIKKIM LIMESTONE (*cretaceous*).—White or grey : when earthy gives a bituminous odour when struck ; 600 feet.

(*l*) GIEUMAL SANDSTONE (*upper jurassic*).—Yellowish, silicious ; darker and calcareous ; sometimes a loose grit and even coarsely conglomeratic ; 600 feet ; conformable to and interstratified with (*k*).

(*k*) SPITI SHALES (*upper jurassic*).—Black crumbling shale, full of calcareous concretions, each generally containing a fossil ; 300 to 500 feet.

(*i*) SHALY SLATES (*jurassic*).—Brown or black, full of broken shells ; 50 feet ; very local, probably belong to (*k*).

(*h*) UPPER TAGLING (*lias*).—Dark, earthy, bituminous ; about 1,000 feet ; difficult to distinguish from (*g*).

(*g*) TAGLING LIMESTONE (*lower lias or rhætic*).—Dark grey brown or black, sandy or earthy, often oolitic and bituminous, sometimes a shell limestone ; more than 1,000 feet ; locally unconformable on (*e*).

(*f*) PARA LIMESTONE (*rhætic or upper trias*).—Black, dolomitic, strongly bituminous, often earthy ; 700 feet ; only found on the north side of the basin.

(*e*) LILANG SERIES (*upper or middle trias*).—Dark limestone, calcareous slates and shales ; limestone compact or fairly oolitic ; 1,000 to 2,000 feet ; locally unconformable on (*d*).

PALÆOZOIC.

(*d*) KULING SERIES (*carboniferous*).—Pale quartzites at base alternating with brown shales ; the latter are often carbonaceous and calcareous, passing into dark limestone ; 100 to 400 feet ; junction with (*c*) conformable, obscure.

(*c*) MUTH SERIES (*upper silurian*).—

3. White quartzite, often speckled ; 200 to 300 feet.
2. Pale sandy silicious limestone ; 300 to 400 feet.
1. Purple sandstone, slaty partings ; conglomeratic, 500 to 600 feet ; conformable to (*b*), slightly alternating.

(*b*) BHABEH SERIES (*lower silurian*).—

3. Greenish and bluish sandstones, sometimes micaceous, often laminated ; also thick slaty and calcareous beds ; thickness not given, but figured as equal to No. 1.

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The Spiti section.

2. Grey white and pinkish speckled sandstone or quartzite, with occasional calcareous beds dolomitic and cavernous; thickness not given, but figured as equal to No. 1.
1. Bluish and greenish grey slates (some micaceous) and sandstones; 3,000 feet.

(*a*) CENTRAL GNEISS.

The several members of this great series are thicker or thinner, or even locally absent, in different parts of the basin; but no decided discordance has been observed, so that it would appear that no considerable disturbance can have occurred here during the immense lapse of time represented by these deposits. There is only a remnant left of the cretaceous rocks capping a ridge in the middle of the basin. The most obscure point of the section is perhaps the basal junction with the gneissic rocks: it is figured as in a manner discordant, but scarcely such as what might be expected if this gneiss had formed a bounding ridge in the silurian sea.

The tertiary rocks of the upper Indus Valley.

Although tertiary rocks do not appear within the trans-Himalayan districts of the Punjab, it is necessary to mention them, as their position and their relations to the older rocks of the region form the most striking stratigraphical feature bearing upon the history of the mountains. Throughout the region east of India, in Burma, and extending even to eastern Bengal (the Assam range), the conformable and even transitional relations between the cretaceous and the tertiary deposits are constant. Similar relations obtain in the region west of India, in Bilúchistán, on the Afghán frontier, and even locally in the Salt Range. In the sub-Himalayan and lower Himalayan regions we have seen, on the contrary, that the lowest tertiary beds rest directly, although with general parallelism, upon very old rocks, either lower secondary, or palæozoic. In the central Himalayan region this isolation of the tertiary deposits is even more marked, because there the whole secondary series is very fully represented, yet the distribution of the two series is as distinct as it could be; they do not even touch at any point. The tertiary deposits occupy a long narrow trough, very closely corresponding, except at its western extremity, with the valley of the Indus, which lies obliquely along the gneissic axis of Ladák. The character of the rocks correspond with such a location as one of original deposition, having on the whole a remarkable resemblance to the Sirmur series of the sub-Himalayan region; thick sandstones and clays of the sub-Himalayan type, with some conglomerates. Mr. Drew found marine or estuarine shells at the western end of the basin near Kargil, and Dr. Stoliczka got nummulites further to the east, near Leh. From some sections it has been shown that the contact with the gneiss is original, not due to faulting. These deposits have undergone great disturbance, the extent of which increases to the east; and on the south side of the Indus they form mountains of considerable elevation, as in the Miru peak (19,577 feet), the level of the river here being about 10,600 feet. The trough is seldom more than 25 miles wide, extending for 200 miles from Kargil to the Chinese frontier, and beyond it into central Tibet. Where Dr.

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The tertiary rocks of the upper Indus Valley.

Stoliczka first observed these rocks in northern Rupshu, they are so indurated and altered that he took them to be a palæozoic formation. It is in and principally along the southern side of the tertiary series that the basic eruptive rocks are so largely exposed. They are already in force close to Kargil, but their greatest development is to the east, where they are no doubt continuous with the similar rocks described by General Strachey about the Manasaraur lakes.

Conclusion regarding the history of the Himalayas.

It is easy to see the leading inference regarding Himalayan history to be drawn from all these facts. It remains true that the rocks now forming the summit of Miru and other higher ground must have been at the sea level at the commencement of the tertiary era; but it is scarcely less clear that a great deal of the work directly connected with the formation of the Himalayas had been accomplished in immediately antecedent time. If we could suppose that the secondary basins of Zanskár and the Karakoram had been continuous, the change between cretaceous and tertiary time would involve the upheaval of the gneissic axis of Ladák as a true centre of elevation, and its conversion by a prodigious denudation into a potential marine basin, through depression. But even supposing that crystalline range to have formed a barrier in the cretaceous seas, a change involving a more or less complete reversal of the distribution of land and water must have occurred before the tertiary deposits could take the place in which we find them. It seems not unlikely that the tertiaries of the upper Indus were once continuous with those of the sub-Himalayan zone; for some remnants of these beds have been observed about Drás, on the watershed lying directly between the present terminations of those regions.

SECTION G.—THE AFGHAN REGION.

The Afghán Region.

The mountains of the North-west Frontier, although confluent with the Himalayan ranges, are distinctly separable from them, on many grounds. The prevailing directions of the two in adjoining areas are more or less at right angles. This feature is most strongly marked in the tertiary rocks along the Jhelum, where throughout a direct distance of more than 100 miles the strike of the beds may be seen to bend even at an acute angle, from north-north-west on the Jamu side to south-south-west in Hazára. The constancy of direction is by no means so marked in the western mountains as in the eastern. This is most plainly seen along the border of the plains, which in each case corresponds with the strike of the ridges and of the strata; the steady run of the sub-Himalayan border contrasts most markedly with the zigzag edge of the hills beyond the Jhelum. And this irregularity is not confined to the border zone of the western area: the principal range is the Hindu Kúsh, with a south-westerly trend, which seems to be continued to the south-west of Kabul in the range between the valleys of the Helmund and the Argandab; but on both sides we find considerable ranges with an east-west direction, as in the Safed Koh running

westwards from Peshávar, and the Koh-i-baba west of Kabul. Again, the Suleman range runs north and south, but between it and the similarly placed ranges in Sind there are the Marri and Bhugti hills having an east to west trend. Any attempt at natural sub-divisions of this ground would be premature from existing knowledge, when on the best maps the features of even the principal ranges are to a considerable extent conjectural. Indeed the best maps of our own completely surveyed districts do not adequately exhibit the characters of the hills; but this is a complaint we shall not get rid of until those who undertake the portraiture of such features understand something of the anatomy of the objects they would represent. It will be convenient to speak of all the trans-Jhelum mountains as the Afghán region. The Salt Range, cis and trans-Indus, would in a manner belong to it, but we have seen that in structure and composition this range is unique, a remnant of an ancient fringe of the peninsular region wholly cut off from the extra peninsular mountains by a broad area of tertiary deposits.

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The Afghán Region.

The gneiss.

The British districts occupy only the outskirts of this great mountain region, principally in Hazára, between the Jhelum and the Indus; but this is geologically the most interesting portion, as including the unaltered rocks outside the gneissic mass that forms almost exclusively the whole region to the north. The deep re-entering bay of tertiary rocks up the valley of the Jhelum stretches far beyond the bend of this river at Muzaffarabad to near Kághán on the Kunhar river in upper Hazára, and here the lower tertiary deposits are in contact with gneissose schists on the flanks of the gneiss itself. The older fossiliferous rocks of Hazára are thus completely cut off from the corresponding rocks of the *Himalayan* region, and the structural distinction of the two regions is further marked by the fact that this gneiss of Kághán is not connected with that of the Himalayan range proper, but with that of Baltistan and Ladák. From Stoliczka's observations it would seem that the gneiss of the Kuenlon and of the Pámír belong to the same mass, and it is presumable that the gneiss of the Hindu Kúsh is its western extension. Within this immense area there no doubt occur numerous outliers of less altered rocks, possibly fossiliferous, preserved in synclinal folds of the gneiss, such as have been mapped by Mr. Lydekker in Baltistan (Memoirs, G. S. I., Vol. XXII), or such as Mr. Wynne has indicated in the Agror district of northern Hazára (Records, G. S. I., XII, p. 123), but the gneiss seems to be continuous throughout. Its southern limits stretch across Hazára through Mansahra to above Amb on the Indus. There is constantly a broad fringe of gneissose schists, and here, as in the outer Himalaya, these dip uniformly towards the gneiss as if passing under it, and in the deep river gorges the outcrop runs far up-stream, further suggesting the actual super-position of the gneiss. The Máhaban mountain trans-Indus is formed of the gneiss, which probably continues thence throughout the range north of the Peshávar valley, and westwards into connexion with the metamorphic rocks of the country about Kabul, and forming the crest of the Safed Koh.

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The Sirban section.

The unaltered rocks forming the hills of southern Hazára (some of which are over 9,000 feet high) present most intricate sections, being much more contorted than is usual in the Himalayan region. Fortunately one of the least disturbed sections, that of the Sirban mountain south of Abbottabad, has been carefully described (Memoirs, G. S. I., Vol. IX), giving a clue to the normal relations of the rocks. The following formations occur there :—

6. Nummulitic : Thick limestones with some shales and fossils in places.
5. Cretaceous : Thin bedded limestones, no fossils found.
   Earthy ferruginous sandy limestone, with fossils.
4. Jurassic : Black Spiti shales, with fossils.
   An erosion unconformity occurs here.
3. Triassic : Thin bedded limestone and slaty shales.
   Dolomite limestone, with fossils.
2. Below the trias : Cherty dolomite, quartzite, breccia and hæmatite.
   Unconformity.
1. Attock slates : Subschistose slates with limestone.

The thicknesses are not given, because they vary much in different sections, but the aggregate of the mesozoic groups (2 to 5) here must be within 2,000′, for the height of Sirban is only 6,243′, and the Abbottabad plain has an elevation of 4,000′; in neighbouring sections the nummulitic beds by themselves (chiefly limestone) attain many hundred feet (perhaps thousands) in thickness. All the groups from 2 to 6 are in parallel super-position, but the group (No. 2) below the trias rests transversely on the edges of the Attock slates, a more total unconformity than has anywhere been observed in the Himalayan region, except that of the Indus tertiaries on the Ladák gneiss. Another point of contrast with the Himalayan area is the development of the nummulitic as a great marine formation in continuous sequence with cretaceous beds, instead of as isolated estuarine deposits. In other respects there is some correspondence with the central Himalayan rocks, as in the identity of the jurassic group with that in Zanskár and Spiti.

The older sedimentary rocks.

As usual, it is with the unfossiliferous deposits that the difficulties of classification arise, and in that category we must still count group 2 of the list. The Attock slates, so called from the hills south of Attock, where they are well exposed, have been generally quoted as silurian, on the strength of some fossils of doubtful identity found long ago in blocks of similar stone from the Khyber hills. If this were confirmed group 2 of the list might possibly represent the carboniferous period. But it has been suggested by Dr. Waagan (Records, G. S. I., XV, p. 183) that the Attock slates may be carboniferous, on the evidence of some undoubtedly carboniferous fossils found by him in the collections of the Geological Society of London, labelled "Punjab," and occurring in a black slate for which he could find no representative unless in this formation. Upon this suggestion he points out that group 2 of the list would normally represent the Muschelkalk and Bunter groups of

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the triassic system, No. 3 being the Keuper, or upper trias. But a leading feature in the puzzle has reference to some rocks not yet mentioned, and described by Mr. Wynne (*l. c.* p. 122) as the Tanáwal ("Tanol") group from the name of the district in which they occur between Abbottabad and the Indus. They are separated from the Sirban mountain by a band of Attock slates four miles wide, and divide these on the other side from the schistose and gneissic rocks of the higher mountains, with which rocks they are described as being associated, and as appearing to pass both into and underneath them. The figured section (*l. c.* p. 117) would imply either that the gneiss of Bahingra is the newest rock of the sequence, or that there is a prodigious inversion of the whole series. Both suppositions would be so extreme that we may assume the oversight of some fault or flexure which will admit of a more reasonable interpretation. The contact of the Tanáwal rocks with the Attock slates on the south-east is described as either a fault or a complete unconformity, the slates being presumably the older of the two. The Tanáwal group is made up of quartzites, dark shaly slates* and cherty dolomites, having some resemblance to group 2 of the Sirban section, although here the dolomitic limestone is the predominant rock, Mr. Wynne however considers the groups to be one and the same, having traced the Tanáwal beds to the north-east into the Tandiáni mountains, on the strike of the Sirban section. Along the eastern flank of the Tandiáni mountains Mr. Wynne traced the Attock slates into contact with the schists bordering the gneiss in the Kunhar valley east of Muzaffarabad where the two are transitionally associated. This observation goes far to settle the later age of the Tanáwal rocks, and so far to confirm their identity with the infra-trias group of Sirban. Here too the Attock slates are within a short distance of the silurian slates, across the narrow bay of tertiary rocks, as mapped by Mr. Lydekker in the Kashmir territory. There seems very little doubt that the two series are the same.

General distribution.

The section described in Hazára is the fullest known in this region, and no other formations have to be introduced. The general distribution is about parallel to that already indicated as the south limit of the gneissic mass. From an almost southerly direction in the north-east, in the Tandiáni hills (8,845 feet), the strike gradually bends westwards, and before reaching the Indus the east-west range of the Safed Koh is fully established. There is however an almost complete break of continuity in the hills, through a great intervening alluvial basin. The mesozoic rocks of Sirban do not extend beyond that mountain to the south-west, in which direction within a few miles the Attock slates gradually disappear under the gravels of the Haripur plain. The Tanáwal rocks extend for some miles along the left bank of the Indus to the south-west from Torbela, and are connected on the south-east with the schists and Attock slates of the Gandgarh range, round the point of which the Haripur plain is confluent with that of Chach facing the plain of the Kabul river on the opposite side of the Indus. The Attock hills are a

* These might well have been the source of Dr. Waagan's carboniferous fossils.

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General distribution.

revival on the strike of the Gandgarh range; but they stop out below Cherat, at Julozai, where the slates are again covered by the gravel slopes south of Peshàwar. There can be little doubt that the Attock slates and probably the Tanáwal beds re-appear to the west in the Afridi mountains, and they most likely occur also along the flanks of the mountains in Yusufzai north of the Peshàwar valley. The newer rocks undergo similar interruptions. The Mianjáni peak (9,793 feet), S.S.E. from Tandiáni, is of Attock slate, but south of it again the Mochpura mountain (9,232 feet), north of Murree, is of nummulitic limestone with occasional outcrops of the jurassic and triassic strata; and these three formations, the nummulitic limestone still predominating, form the broad band of hills to the south-west, terminating in the Margála range. Through the Margála pass there is a narrow continuous outcrop connecting this range with the Chitapahár range, south of the Attock hills, and passing westwards into the range of the Kotal pass, north of Kohát. They probably extend far into the Afridi country. Some considerable hills of the nummulitic and mesozoic rocks occur, isolated in the plain south and west of Hassan Abdal.

The Peshàwar depression.

The large basin of depression, the greater part of which is known as the Peshàwar valley, is a remarkable feature the origin of which is not very clear. Its outline, as already indicated, is very irregular, long spurs or ranges stretching into it from the surrounding mountains as if it had formerly been produced by the erosion of the rivers that have subsequently filled it up again. Considering its position, and the extent of hilly ground, sixty miles in a direct line along the gorge of the Indus, by which it is separated from the great plains of the Punjab, its low elevation is remarkable, only 1,100 feet at the trigonometrical base-line on the Chach plain close to the Indus, and 1,250 feet at Peshàwar. The present surface is largely made up of diluvial gravels from the hills around, so there is a considerable rise to the margin of the area; at Hassan Abdal the level is 1,400 feet, and at the Margála pass 1,700, which is the level of the Potwar plateau at Rawalpindi. Mr. Theobald (Records, G. S. I., XIII, p. 230) has given fair evidence to show that the Indus was formerly confluent with the Haro river near the point of the Gandgarh range, and that its present junction with the Kabul river where it enters the gorge at Attock is of recent date. Some interesting information regarding the depth and composition of these deposits has recently (1883) been furnished from a boring that was made in the futile expectation to find the nummulitic coal in a more favourable condition beneath the alluvium than in the Chitapahár hills close by. A hole was put down in the bank of the Haro, 70 feet below the level of the plain, at two miles from the Indus and about one mile from the nearest point of the hills. It was stopped at a depth of 252′ 6″ in consolidated sand, but from 121′ to 233′ the section was all in yellow and blue clay. The position, being close to the outlet of the basin, shows how steep its lower rock margin must be. The excavation of this basin may well have been effected in tertiary times, but it is probable that considerable depression has occurred consequent on the accumulation of deposits.

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The tertiary basin.

We have already seen the lower tertiary rocks as massive nummulitic limestone taking a conspicuous place in the higher hills of Hazára between Murree and Abbottabad in parallel sequence with upper mesozoic strata. There is however a very marked feature, probably involving a considerable fault, separating that ground from the exculsively tertiary area to the south; and it is continuous with the main tertiary boundary of the sub-Himalayan region. It is well marked west of Murree and along the base of the Margála and Chitapahár ranges, and Mr. Wynne has traced it even beyond the Indus, north of Kohát. The tertiaries in the sub-Himalaya appear as a zone fringing the mountains and passing under the alluvium of the plains, but from the Jhelum to beyond the Indus at Sheikh Budin they lie in a basin, between the old rocks of the Salt Range and the Afghán mountain region. It cannot be asserted that the Salt Range was an original limit of deposition for these deposits. There is indeed positive proof that it was not so absolutely, for in several places, as at the Chambal ridge (east end of the range) and west of the Indus near Kálábágh, upper tertiary strata occur on the outer base of the range. But that it was so, at least partially, especially for the lower tertiaries and for the east end of the range, is demonstrable. The nummulitic series here is scarcely a twentieth of its thickness in the northern outcrops, and there is an abrupt passage, with something like an erosion unconformity, from the nummulitic limestone to mammaliferous Siwálik clays and sandstones, instead of the graduated transition that marks this horizon in the mountain region. A question of some little interest has been raised as to the correlation of the nummulitic beds of the sub-Himalaya and of the trans-Jhelum sections. The massive sandstones and red clays forming the ridge on which Murree is built are underlaid on the west by finer variegated clays with earthy nummulitic limestone: the section is exactly like those in the Sirmur area south of Simla, the upper beds corresponding with the Dagshai group and the lower ones with those of Subáthu; and those particular beds close to Murree are undoubtedly at the top of the nummulitic series and probably higher than the massive limestone of the mountains to the west. From this section Mr. Wynne in all his papers on these rocks has treated the Subáthú group as a distinct upper member of the nummulitic series. But this name had been already appropriated to the whole nummulitic series in the sub-Himalayan region, and it is almost certain that the bottom beds of Subáthú are on the very lowest nummulitic horizon. The presumption is that the strong limestones of the Hazára hills and of Kohát have taken the place of the brown estuarine clays that so prevail in the sub-Himalayan region. From Murree to the south-east there is an ascending section, though with faulted repetitions, through an enormous thickness of middle and upper tertiary deposits, precisely resembling and actually continuous with those of the sub-Himalayan zone, but in the Jhelum and Rawalpindi districts they form a wide synclinal basin, with numerous secondary flexures. The whole is now plained down into a broad upland, known as the Potwar, much intersected in all directions by deep ravines eroded in the soft Siwálik strata. In

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The Suleman Range.

The tertiary basin.

Mr. Lydekke's Synopsis of the fossil vertebrates of India (Records, G. S. I., XVI, 2) the indication "Punjab" refers mostly to this ground where some rich collections of bones have been made, chiefly in the south-east part of the district, as about Asnot, west of Mount Tilla. Numerous fossils of a lower horizon have been found south of Kushalgarh, on the Indus. West of the Indus, in Kohát, the nummulitic group is more broadly exposed, and is here associated with, or at least immediately overlies, immense deposits of rock salt described in a previous section. The east-west strike is still steady here, but at the Kurram river it seems to change abruptly into the north-south strike of the Sulemán axis, and here, on the right bank of the river opposite Thul, Mr. Wynne observed the lower tertiaries to be extensively invaded by basic trappean rocks, a condition almost unknown throughout the whole tertiary region to the east.

SECTION H.—THE SULEMAN RANGE.

The Sulemán Range.

It is only as a background that the Sulemán range can be introduced into a sketch of Punjab geology, for from Bannu southwards the frontier lies at the base of the hills, on the gravel slopes bordering the alluvial plains of the Indus, with the exception of a small slice of the Mari and Bugti hills west of Rajanpur in the Dera Gházi Khan district. The range is but the eastern edge of an immense tract of mountainous country stretching indefinitely westwards, and the drainage for a considerable distance passes through the Sulemán ridge into India. In the regions previously described the older rocks are predominant, but the region of which the Sulemán is only a fragment, including Southern Afghánistán, all Bilúchistán and the greater part of Persia, is almost exclusively made up of tertiary and cretaceous deposits with eruptive rocks of the same ages.

It is only of the southern part of the Sulemán that we have any accurate geological knowledge, as recently described by Mr. W. T. Blanford (Memoirs, G. S. I., Vol. XX). He gives the following list of the rocks exposed :—

4. SIWALIK, or Manchhar (of Sind) :
   - Upper (*pliocene*) : conglomerates overlying sandstones and clays with conglomeratic bands ; 2,500 feet.
   - Lower (*upper miocene*) : sandstones, clays, marls, bone beds, &c. ; 5,000 feet.
3. NARI (*miocene*) : sandstones, clays, &c. ; 2,000 feet.
2. EOCENE :
   - Upper : olive clays, shales, sandstones, &c., with a few thin bands of nummulitic limestone and occasional coaly beds ; 7,000 to 9,000 feet.
   - Lower : coarse brown sandstone with a band of limestone breccia ; 1,000 feet.
1. CRETACEOUS :
   1. Hard whitish sandstone grit ; 1,500 feet.
   2. Dark grey limestone passing down into limestone shales ; 1,000 feet seen.

The Sulemán Range.

There is considerable difference between this section and that known in Sind. The whole Gáj group (a marine formation some 1,500 feet thick) is wanting between the Nari and Siwálik horizons, as is also the oligocene marine limestone at the base of the Nari group, thus bringing the upper tertiary series here into closer correspondence with that found in the Potwar and the sub-Himalaya as exclusively of fresh water or subærial formation. There is also a remarkable deficiency of limestone in the eocene series of the southern Sulemán as compared with the sections both in Sind and in the Upper Punjab. No unconformity has been detected throughout this enormous sequence of strata, notwithstanding the apparent gaps; but it is clear that disturbance commenced long before the deposition of the newer beds which now fully partake in that disturbance, for the top conglomerates, which are now themselves often tilted up to the vertical, are formed of the *debris* of the rocks of the main ridge, which must therefore have been partly upraised and undergoing denudation in the Siwálik period. Similar evidence of the slow process of mountain formation has previously been quoted from the sub-Himalayan region. The Sulemán ridge is an anticlinal flexure, only greater than those on either side of it, whereby the older (cretaceous) rocks are brought up and exposed by denudation along the crest. From the evidence of stones in the stream beds it has been asserted that older formations come to the surface at the north end of the range, as is not at all unlikely. The Siwálik rocks only are found along the outer margin next the plains.

Mr. Griesbach, who accompanied the expedition to the Takht-i-Sulemán in December, 1883, has given an outline of the geology, in which there are some striking differences from the section described by Mr. Blanford 40 miles to the south. The whole crest of the range at and about the Takht is formed of pale marine coral limestone many hundred feet in thickness, resting on a sandstone which Mr. Griesbach identifies with the cretaceous sandstone of Mr. Blanford's section, and he considers the limestone also to belong to that epoch. Another striking contrast is that the Siwáliks are represented as resting completely unconformable on the edges of lower eocene strata.

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The Moghal occupation and rise of the Sikhs.

The modern history of the Punjab, as a distinct and independent part of India, may be said to have commenced in December, 1763, and to have closed with the battle of Gujrát on the 22nd of February, 1849. From almost the earliest days of the Mussalmán invasions, the Province of Lahore had followed the fortunes of the transient kingdoms that alternately rose and fell at Ghazni, at Kabul, and in Delhi, till it was incorporated in the more stable empire founded by Baber; and for upwards of two hundred years the Punjab enjoyed comparative peace and prosperity under the rule of the Moghal kings. The country between the Indus and the Sutlej lies as the natural outwork of Hindústán against eruptions from the North. It was consequently the first to feel the blow that shook the foundations of the Moghal Empire, and precipitated its dissolution. The Moghal Governor of Lahore appears to have given his masters ample warning of the storm that was about to burst on Upper India, but his intelligence was received unheeded by the Delhi Court, and, in 1738, Nádir Sháh crossed the Punjab without opposition, returning by the same route after the capture and sack of Delhi in 1739. There followed in the Punjab an immediate collapse of the already much-weakened authority wielded by the provincial governors of the Moghal kings. For the next thirty years the history of the Province is the record of the selfish intrigues and struggles for independence of the Moghal representatives, till, in 1747, Lahore fell before the Dúráni troops, and the Punjab was gradually, and not without some feeble efforts on the part of the Delhi king to check the Afghán advance, incorporated in the dominions of Ahmad Sháh, Abdali. The Afghán tenure of the country cis-Indus, however, appears to have been of the weakest, even after the victory of Pánipat made Ahmad Sháh, for the time, the arbiter of Northern India. His attention was directed more to his native country and Persia than towards consolidating his power in the East; and, although he repeatedly overran the Punjab, on the eighth and last occasion in 1767 he made no effort to establish a permanent administration. The Dúráni Governors were left to shift as they could; the people did what they liked; at the periodical appearances of the Sháh the revenue was plundered rather than collected; and whenever the Afghán armies retired the country reverted to its normal condition of lawlessness and disorder. During this period of confusion the Sikhs were gaining in numerical strength and political importance. They appeared first as bands of marauders, issuing from fastnesses in the low hills along the base of the Himalayan ranges from the Chenab to the Sutlej, animated by a common religious enthusiasm and a common hatred of Muhammadans. It would be out of place here to dwell on the anti-Mussulmán revival in the North, which was almost contemporary with the rise of the Hindu Mahrattas in

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the South, or to trace at length the process in the course of which a sect of harmless devotees was developed into a body of bold and determined robbers, the avowed enemies of the Mussulmán rulers of the plains; and eventually into a powerful State. Suffice it to say that the change must be traced directly to the persecution they suffered at the hands of the Emperors Aurangzeb and Bahádur Sháh, which at one time had nearly extinguished the sect. After the defeat and execution at Delhi of Banda, the disciple of the last Sikh Gúru, Govind Singh, till the invasion of India by Nádir Sháh, a period of nearly thirty years, nothing is heard of the Sikhs; but when that conqueror had seized Delhi, and the empire was fast falling to pieces, they are stated to have taken advantage of the confusion that followed, and to have plundered the peaceable inhabitants of the Punjab who had removed their property to the hills for safety from the Persian invaders. Enriched with these spoils, the Sikhs emerged from the hills and built a fort on the Ravi, whence they made predatory incursions and are said to have harassed the army of Nádir Sháh on its way home to Persia laden with booty. The oppressions and exactions of the powerful in that time of trouble drove the impoverished Jat zamíndárs of the Punjab to despair. As a bond of union and strength against their oppressors they resuscitated the latent fire of the Sikh ritual. The spirit of the revived sect displayed itself at first in secret associations and isolated acts of depredation. The neglect or feebleness of the ruling authority enabled the associations to prosper. The more successful leaders gathered followers round them. The cause became popular, the number who joined the nucleus of malcontents augmented rapidly, and in a few years the Chiefs were able to form encampments in open defiance of the ruling authority, to approach the sacred city of Amritsar, and to maintain themselves in its vicinity. The different associations were held together by a common interest, no less than by the profession of a new faith; and a system of general confederation for defence or for extensive operations requiring more than single efforts was early arranged between the Chiefs. During the earlier invasions of Ahmad Sháh, the Sikhs appear to have scattered before the danger, only to re-form when it was passed. After a time, seizing the opportunity afforded by the convulsions of the expiring Moghal Empire, they slowly encroached, till, in 1762, the Afghán Governor of Lahore could scarcely show himself beyond the walls of the city, and the annual assembly of all Sikhs was publicly held at Amritsar. The report of these events brought down Ahmad Sháh. At Barnála, not far from Ludhiána, the Sikhs, for the first time, met the Afgháns in the open field, and the result was a crushing defeat, their loss being estimated at 20,000 men. But no sooner had the Sháh returned to Kabul than the Sikhs began to recover their courage and to coalesce against the Muhammadans. They united to make one great effort against Sirhind. An assembly was called at Amritsar and 40,000 Sikhs marched on Sirhind. Zain Khán, the Governor, was defeated and slain in December, 1763, and the town of Sirhind was destroyed. This event fitly marks a fresh departure in the history of the Punjab. That it was recognized to be so by

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the Sikhs themselves is evinced by the fact that they now commenced to strike coin, the immemorial sign of a declaration of independence in the East. They had ceased to be mere robbers, and henceforth formed a distinct body with clear political aims and asserting well-defined aspirations, which were soon to be fulfilled.

The Sikh Confederacy.

It will be convenient to give at this stage a brief sketch of the Sikh political system, more especially with reference to the confederacies which flourished for the next thirty years. Allusion has been made above to the circumstances which compelled a confederation for joint purposes of the different Sikh leaders with their followings. Theoretically, all Sikhs are equal. Their religion, a pure theocracy, allowed no distinctions of rank among the members of the "Khálsa," or mystic commonwealth of the disciples of Gúru Nának. But, in practice, the Sikhs naturally grouped themselves under the leadership of men known for their sagacity, courage or daring. The tie that bound the follower to his Chief was however soluble at the will of either. All that a Sikh Chief asked from a follower in those days was a horse and a matchlock. All that a follower asked was protection and permission to plunder under the banner of the Chief. The Sikhs could transfer their services to whom they pleased, or they could themselves, if fortunate, become leaders and acquire new lands in the name of the Khálsa. The need for joint action, however, soon compressed the many bands of Sikhs into twelve great confederacies or "misls"; they did not all exist in their full strength at one time, but one misl gave birth to another, or rose and fell in power according to the popularity or capacity of its leader. Each misl followed a Chief, called "Sardár"; but the title was of general application to the head of a small independent collection of Sikh horsemen as well as to the Chief of a great confederation. The plunder and conquest of a misl were divided in equal shares among its members, after setting apart a portion for the Sardár. A bond between the confederacies was supplied in the solemn assembly of the whole Sikh people, which met year by year at least once at Amritsar. There the council of the Chiefs, termed the "gúrúmata," discussed affairs affecting the Khálsa, or planned new expeditions. Further than this, there was no law and no government; in private life each Sikh was free to act as he pleased, controlled only by the strong hand of his neighbour and the force of public opinion. That such a state of things could not endure long in the Punjab, after the link of a common enemy and common danger had been removed, is obvious. The prescient eye of the traveller Forster, in 1783, just after the birth of Ranjít Singh, foresaw already that "some ambitious Chief, led on by his genius and success, absorbing the power of his associates, would display from the ruins of their commonwealth the standard of monarchy." For a generation, however, the system worked sufficiently well; the Sikhs extending their power westwards up to the Jhelum river, and, in the east, as far as the Jumna. Their predatory excursions reached to Mooltan in the south, and to Garhwal and Rohilkand towards Hindústán. When not plundering abroad, the Chiefs were busy preying on each other and prosecuting petty feuds.

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The rise of Ranjít Singh.

In 1793, Zamán Sháh, whose mind seems to have been filled with the idle hopes of an Indian Empire, succeeded to the throne of Kabul. He descended on the Punjab, in 1797, with 30,000 men, but was recalled by a rebellion in Afghánistán, after taking the city of Lahore. The Sikhs, as usual, gave way before the compact army of the Dúránís, to close upon them and harass them on their retreat. In 1798, the Sháh advanced again and entered Lahore without opposition; but after a few months' stay there, finding it impossible to make any arrangements for the permanent occupation of the country, or to render the Punjab in other respects a source of advantage to himself, he retraced his steps to his hereditary dominions west of the Indus, and the Sikh Sardárs returned, each to the territories he had acquired and had evacuated on the Sháh's approach. Intelligence of designs by Persia upon Herat hurried the departure of Zamán Sháh. He found the Jhelum swollen with the winter rains, and was unable to take his guns across. Being pressed for time, Zamán Sháh wrote to Ranjít Singh, the youthful Sardár of the Sukarchakía misl, whose head-quarters were at Gujránwála on the road from Lahore to Jhelum, to forward the Afghán artillery to the Sháh's representatives at Pesháwar. With that keen political perception which guided him so successfully throughout his life, Ranjít Singh had seen that the possession of the provincial capital of Lahore would give him a prestige and power without which he could not hope to carry out the plan he had formed of welding the many Sikh confederacies into one commonwealth with himself as its head. He promptly availed himself of the opportunity given by a chance flood of the Jhelum. A bargain was struck, and Ranjít Singh sent on most of the Afghán guns, receiving in return a royal investiture of the governorship of Lahore. In the same year he established his authority in the city, with the aid of his mother-in-law, the famous Mái Sadda Kaur, the virtual head of the powerful Kanhya misl. Firmly seated in Lahore, Ranjít Singh proceeded by force, fraud or conciliation to extend his power. The next seven years were spent in the systematic reduction of the independent Sikh Chiefs in the country between the Jhelum and the Sutlej by the joint forces of the Sukerchakía, Kanhya, and Ahlúwália confederacies under the hegemony of Ranjít Singh. At the same time periodical raids were made on the Muhammadans of Jhang and Mooltan. Throughout these years Ranjít Singh was steadily labouring to give coherence to the scattered elements of the Sikh people; his task was lightened by the mutual jealousies of the Sardárs, which made them incapable of united opposition to his encroachments, and no doubt also by the growing conviction of the Sikh people that it was better that there should be one head to the commonwealth, and that this head should be Ranjít Singh.

His early relations with the British.

The year 1805 witnessed the extinction of the system of confederacies acting in grave matters jointly for the Sikhs. In that year the last Gúrúmata was held; and thereafter the force of the Khálsa was directed by the will of one man. The year is also eventful in other ways. Jaswant Rao Holkar, flying before the army of Lord Lake, reached Amritsar at the time when the Sikh

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Chiefs were collected there in council. They declined to assist the Mahratta. After some desultory negotiations, he made terms with Lord Lake, who had arrived on the banks of the Beas; and the hostile armies retired from the Punjab, after the conclusion of an agreement between Ranjít Singh and the British Commander, on the one part binding Ranjít Singh and Fatteh Singh Ahlúwália, his ally, not to aid Holkar, and on the other stipulating that British armies would respect Sikh territory so long as no cause for offence was given. It was the first contact of the trans-Sutlej Sikhs with the English. Indirectly, the events of 1805 bore enduring consequences, for there is no doubt that the destruction of the Mahrattas by Lord Lake produced a deep and lasting impression on Ranjít Singh, and induced him ever after to avoid a collision with the English. In 1806, Ranjít Singh commenced to lay his hands on the possessions of the Phulkían misl on the left bank of the Sutlej, without neglecting to profit by his neighbours towards Kángra and Mooltan. Towards the close of 1808 his permanent occupations on the south of the Sutlej had thoroughly excited the alarm of the Sikh Chiefs situated between that river and the Jumna, and in response to their appeals a British mission under Mr. Metcalfe was sent to Ranjít Singh. It was considered advisable to keep the Cis-Sutlej States intact under British protection; there were, at the same time, projects being formed in Europe for a Franco-Russian invasion of India, and it was necessary to ascertain the condition of the countries and the feeling of the people lying beyond the then north-western frontier of the British possessions. Ranjít Singh entertained the British envoy for months with evasive promises and endless negotiations, till the despatch of troops to Ludhiána and Umballa suddenly warned him that the British Government was in earnest. Having learnt the lesson conveyed in the Mahratta wars, much impressed by the manner in which the envoy's escort of sepoys repulsed an attack of Sikh fanatics, and conscious that a rupture with the English would be the signal for the rebellion of the many Chiefs he had recently suppressed, Ranjít Singh wisely resolved to settle his relations once for all with the English. In April, 1809, he signed the treaty of Amritsar, by which he entered into an engagement to preserve friendship with the British Government, and not to encroach on the left bank of the Sutlej. In return the British Government promised to have no concern with his territories to the north of the Sutlej. To the close of his life Ranjít Singh scrupulously respected the treaty, and never wavered from the position he then took up towards the English.

He extends his dominions.

Barred by the British power towards the East, he turned to the West for that field of conquest and war without which it is doubtful whether he could have maintained his power as virtual sovereign of the Khálsa, although in name professing only to be its representative. He seized the fort of Kángra towards the end of 1809, and next year overran Gujrát and Jhang, finishing with an unsuccessful assault on Mooltan. About this time he commenced to form regiments of paid and drilled soldiers, accompanied by a distinct corps of artillery on the British model. In 1811, he finally reduced the Faizúllapúría misl, located in the Jullundur Doáb,

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completing the absorption of the old confederacies trans-Sutlej. The troubles of the Saddozai kingdom now gave Ranjít Singh an opening in the direction of Pesháwar. Wazír Fatteh Khán, Barakzai, came to the Indus in 1812 to punish the adherents of Sháh Shúja, and to recover the province of Kashmir for his nominee to the Kabul throne, Sháh Mahmúd. Ranjít Singh was at the same moment engaged in reducing the Chiefs of Bhimbar and Rajauri on the passes leading to Kashmir. It was accordingly arranged that Ranjít Singh should admit the Afgháns to the passes, and place a force of Sikhs at the Wazír's disposal, receiving nine lakhs of rupees and a detachment of Afgháns to be employed against Mooltan as the price of his assistance. But Fatteh Khán's troops outstripped the Sikhs and captured Kashmir single-handed. Ranjít Singh thereupon seized Fort Attock on the Indus. Negotiations on the part of Fatteh Khán for its release were ineffectual; and, in July, 1813, a drawn battle between the Sikhs and Afgháns left the fort in possession of Ranjít Singh. In the same year he extorted the Koh-i-Núr diamond from Sháh Shúja, then a refugee at Lahore. In the following year he made an unsuccessful attempt to conquer Kashmir. In 1816 he ravaged Bhimbar and Rajauri. After a rest of two years Mooltan was stormed in 1818. A few months after the fall of Mooltan, Wazír Fatteh Khán was killed by the order of Sháh Mahmúd; the Barakzais rose immediately in rebellion, and the Saddozai kingdom was dissolved. Ranjít Singh resolved to carry his army across the Indus, and a rapid dash was made at Pesháwar, which the Sikhs entered in November, 1818. The occupation was, however, short, and intended merely to cover the erection of fortified posts on the right bank of the Indus, opposite Attock. In 1819, he was occupied in taking Kashmir; in 1820, he led his army towards Baháwalpur and Dera Gházi Khan. The next year was spent in consolidating the conquests west of the Jhelum. No event of importance occurred in 1822, except the arrival of European military adventurers at the Court of Lahore, who were engaged to impart European drill to the Khálsa army. In 1824, further operations took place against Pesháwar. Sardár Yár Muhammad Khán, who held the place for the Barakzai family, made his submission at the approach of the Sikh army; but Muhammad Azim Khán, his elder brother, repudiated Yár Muhammad's action. Ranjít Singh thereupon crossed the Indus. At Naushera, on the Kabul river, he was confronted by the levy *en masse* of the Yusafzai peasantry, eager to fight for the faith. A desperate struggle ensued; more than a thousand Sikhs were killed by the undisciplined villagers, who were themselves routed at the close of the day with great slaughter. On the 17th March, 1824, Ranjít Singh made his entry into Pesháwar. After parcelling out the valley between Yár Muhammad Khán and his brothers, to be held by them on payment of tribute, he returned to Lahore. No military enterprise was undertaken in 1825 or 1826. In 1827, the fanatic Sayad Ahmad raised the standard of a holy war against the Sikhs in the Pesháwar Valley; but during the year a detachment of Sikh troops, under Budh Singh, Sindhanwália, inflicted a temporary check on the Gházís, near Akora. In 1829, Sayad Ahmad re-appeared, defeated

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Yár Muhammad Khán (who was killed in the action), and seized the city of Peshawar; Ranjít Singh then took the field in the early part of 1830 to punish the Gházís, but on his crossing the Indus the insurgents melted away before him, and he returned, having appointed Sultán Muhammad Khán Governor of Pesháwar. Shortly afterwards the Yusafzais, tired of Sayad Ahmad, rose against his rule, and he fled across the Indus to Hazára, where he was killed, in 1831, in a skirmish with the Sikhs.

His closer relations with the British.

During these years the relations of the British Government with Ranjít Singh had been drawn closer by the interchange of friendly missions and presents. The time seemed to have come for a meeting between the Governor-General and the Maharája, and for dynastic reasons Ranjít Singh was anxious to appear before the world as the special friend of the British Government. Lord William Bentinck and the Mahárája accordingly met in great splendour at Rúpar in October, 1831. No business of importance was transacted at the interview, except that a written assurance of perpetual friendship was given to Ranjít Singh; but in the spring of 1832, a treaty providing for the free navigation of the Indus and Sutlej rivers by British merchants was concluded with him. From this period the Mahárája seems to have dismissed from his mind all distrust of the British Government, and, indeed, to have entertained sentiments of real friendship for the English. In 1834, the unfortunate Sháh Shúja made another attempt to recover his kingdom, and while he engaged the Barakzais at Kandahar, the Sikh troops captured Pesháwar. The Barakzais defeated the Sháh, and then turned towards Pesháwar. After a period of desultory fighting, Muhammad Akbar Khán, the eldest son of Dost Muhammad Khán, engaged the Sikhs at Jamrúd, the mouth of the Khaibar Pass, and defeated them with the loss of Sardár Hari Singh, the bravest General in the Khálsa. The event caused some anxiety, and reinforcements were pushed up at great speed to relieve the beleaguered garrison of Jamrúd. The Afgháns, however, knowing their own weakness, did not risk another action, but returned to Jalálabad.

Death of Ranjít Singh.

We now come to the period of an important transaction, the restoration of Sháh Shúja to the throne of Kabul by the joint aid of the British Government and the Mahárája. Considerations, into which it is unnecessary to enter here, had determined the Governor-General to overthrow the Barakzai family that ruled in Afghánistán, replacing it by the long-exiled Saddozai king. A tripartite treaty was executed in 1838 between the three powers. Preparatory to the commencement of the campaign an interview took place between Lord Auckland and Ranjít Singh in November, 1838, at Ferozepore; shortly after it the Governor-General visited Lahore and Amritsar, and was everywhere magnificently received. It was then observed that the Mahárája appeared feeble and worn out, and a few months after his eventful life closed on the 27th of June, 1839, at the age of fifty-nine. Considered from one point of view, the career of this extraordinary man had been an absolute success. He found the Punjab a waving confederacy, a prey to the factions

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of its Chiefs, pressed by Afgháns and Mahrattas, and ready to submit to English supremacy. He left it a powerful kingdom. He found the military force of his country a mass of rough, undisciplined horsemen, and left it a large and well-drilled army, supported by three hundred guns. Further, he had the wisdom to avoid coming into conflict with the English without any loss to his own dignity or position. But where he may be said to have failed is that he did not create stable political institutions in place of what he had destroyed. The military despotism he had formed gave no promise of permanence, depending as it did entirely on the will of the army. The national and democratic instincts of the Sikhs were concentrated in the armed Khálsa, and as soon as the soldiers learned their power, neither the king nor the people could avail to withstand them. Much of the trouble, too, that befell the Sikh government after Ranjít Singh's death may be traced to the inordinate power he had permitted his favourites to acquire, at first no doubt intentionally as a counterpoise to the old Sikh Sardárs of the misls, and latterly from the force of habit and the weakness of a wrecked constitution and early old age. Foremost in influence and ability of the favourites were the three Dogra brothers from Jummoo, Guláb Singh, Dhián Singh, and Suchet Singh; next came Jamadár Khushál Singh, originally a Bráhman, from a village near Meerut; other leading men at Court were the Sindhanwália Sardárs, distant relatives of the Maháraja; Faqír Azízúddín, who was throughout the trusted counsellor of Ranjít Singh and practically his Foreign Minister; Bháis Govind Rám and Rám Singh, and Misr Beli Rám, the Treasurer. As regards the internal administration of the country, the Government of Ranjít Singh seems in many respects to have been better than the contemporary governments of neighbouring independent Native States. There were no regular courts of justice; trade was hampered everywhere by duties and State monopolies; there was no attempt to develop the country; and the attention of all officials was mainly directed to the realization of the revenue. But oppression beyond the customary degree was punished, the country from the Indus to the Sutlej enjoyed peace, and the comparatively mild system of government, such as it was, no doubt was popular, and suited to the still untamed tastes of the people.

Events subsequent to Ranjít Singh's death.

The Maháraja was succeeded by his son, Kharak Singh, with Rája Dhián Singh of Jummoo as Wazír. Maháraja Kharak Singh's character was weak, almost imbecile, and utterly incapable of controlling the elements of disorder which the removal of the firm hand of his father was about to release from confinement. Towards the end of October, 1839, the Maháraja gave great offence to Dhián Singh by taking into his favour a favourite named Chet Singh, a man of low birth and no capacity. With the active assistance of Maháraja Kharak Singh's son, Nao Nihál Singh, whose energy of character and ability gave great promise, Chet Singh was murdered by the Dogra party, and thenceforth Kharak Singh was allowed little voice in State affairs by Nao Nihál Singh and Rája Dhián Singh. At the same time, Nao Nihál Singh was secretly preparing for a decisive struggle with the Dogra brothers. In the midst of the preparations Maháraja Kharak Singh died in November, 1840. Upon

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the conclusion of the funeral rites the new Mahárája Nao Nihál Singh, and his Court, including all the members of the Jummoo family, except Rája Guláb Singh, were passing through a covered gateway when a portion of the structure fell and killed both the Mahárája and the eldest son of Rája Guláb Singh, who was seated on the same elephant. The throne of Lahore was again vacant. It was claimed by Sher Singh, a reputed son of Mahárája Ranjít Singh. A short *interregnum* followed; the mother of Nao Nihál Singh, supported by the Sindhanwália Sardárs and Guláb Singh of Jummoo, claimed the regency, at any rate till it became certain that a posthumous son would not be born to Mahárája Nao Nihál Singh. On the other hand, Rája Dhián Singh was in favour of the claims of Sher Singh, but, considering the temper of the Sikhs, thought it better to wait. A council of regency was accordingly arranged. But it managed affairs badly; the army became discontented, and gradually declared for Sher Singh. He suddenly appeared before Lahore in January, 1841; Rája Guláb Singh closed the gates of the citadel and defended himself with great obstinacy till his brother, Dhián Singh, arrived from Jummoo and negotiated a surrender. Sher Singh was then proclaimed Mahárája, and the Sindhanwália Sardárs were banished. The soldiers profited by the *coup d'état* to break loose; they murdered obnoxious officers, and plundered the city of Lahore; nor was the spirit of violence confined to the troops at the capital; it spread to Kashmir and Peshâwar; in the former place the Governor was killed and in the latter the soldiery were only curbed by a threat to raise the surrounding Muhammadan population against them. A general plunder of the Punjab was universally expected. Towards the summer of 1841 the disturbances subsided; but the evil had been done, the army had now learnt its strength, and henceforth it was no longer the instrument of the Mahárája's government, but considered itself, and was regarded by others, as the representative body of the Sikh people, as the visible Khálsa and master of the commonwealth. In military matters the troops still obeyed their officers, but the attitude of the army relatively to the executive government of the country was solely determined by an assemblage of committees or "pancháyats," which were composed of men selected by each regiment in consideration of their general character as faithful Sikh soldiers or for the influence they possessed with their comrades. In November, 1841, the insurrection broke out in Kabul, which terminated in the annihilation of the British army in Northern Afghánistán, the gallant little force at Jalálabad excepted. The disaster appears to have had no effect, at the time, upon the Sikhs; Mahárája Sher Singh gave willing aid in the collection of supplies for the troops under General Pollock, and a Sikh contingent was present at the forcing of the Khaibar and the relief of Jalálabad. Sher Singh was now becoming impatient of the Jummoo party. In June, 1842, the mother of Nao Nihál Singh had been killed—an event from which Rája Dhián Singh derived increased influence; but in October, 1842, the Mahárája recalled the Sindhanwália Sardárs, and the history of the remainder of his reign is occupied by the intrigues of the opposing factions at his court, the Jummoo brothers on one side and the Sindhanwálias

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on the other being the leaders. Eventually, the aims of both factions became practically the same—to destroy their enemies together with the Maháraja, and then to reign supreme over the Punjab as the guardians of the young Dalíp Singh. The Sindhanwálias took the initiative. On the 15th September, 1843, they killed Maháraja Sher Singh and his son Partáb Singh, and on the same day also Rája Dhián Singh. They then seized the fort at Lahore and proclaimed Dalíp Singh Maháraja, and Lehna Singh Sindhanwália his Wazír. But they had neglected to secure Rája Suchet Singh, the brother, and Rája Híra Singh, the son of the murdered Minister. By extravagant promises these two gained the troops over to their side; they surrounded the fort, took it after a desperate resistance lasting two days, and the tragedy ended with the deaths of the Sindhanwália Sardárs, and the proclamation of Dalíp Singh as Maháraja with Rája Híra Singh as his Wazír. During these troubles the soldiery plundered Lahore. The new Minister raised the pay of the common soldiers by two and a half rupees a month, and the troops realized that they were the uncontrolled masters of the kingdom. From this stage onwards to the close of the second Sikh War the proceedings of the army constitute the history of the Punjab. Rája Híra Singh's administration is a series of efforts to conciliate the troops Rája Suchet Singh, his uncle, made an endeavour to supplant him, but the attempt was crushed with ease and Suchet Singh was killed. Next, Sardár Attar Singh Sindhanwália, the surviving brother of the Sardárs who killed Maháraja Sher Singh, rose against Híra Singh, but was defeated and slain by the troops who were still faithful to the young minister. In the same action Kashmíra Singh, a reputed son of Maháraja Ranjít Singh, was killed on the side of the rebels. So far, the young son of Dhián Singh had, in his acts and successes, surpassed the general expectation, and an interval of some months was passed in comparative quiet. But on the 21st December, 1844, another sanguinary revolution annihilated the few vestiges of a regular government that remained at Lahore. The fall of Híra Singh may be attributed to the agency of three parties—the old Khálsa Chiefs who always dislike the Dogra family; the mother and uncle of the young Maháraja who thirsted for power; and the army whose interest it was to have rapid changes of the ruling power. On the 21st of December Jowáhir Singh, uncle of the Maháraja, presented the boy to the soldiers on parade, and exhorted them to remove a wicked minister who meditated the destruction of their sovereign, promising large donations to the troops if they complied with his wishes. Rája Híra Singh fled with a few companions, but was overtaken and killed by the soldiers. His house and treasure were made over to the army. All operations were now openly undertaken by the sole direction of the army committees or pancháyats. Their first act was to attempt to extort a fine from Rája Guláb Singh of Jummoo; by a mixture of force and conciliation he contrived to evade the danger; and, declining the office of Wazír, saw Jowáhir Singh installed as vice-regent for the Maháraja in May, 1845. In the same month the daughter of Sardár Chattar Singh Atáríwála was betrothed to Dalíp Singh. The government of Jowáhir Singh

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and his party proved to be despicably weak and corrupt. Peshora Singh, another reputed son of Ranjít Singh, conceived that the opportunity had come to seize the throne, and proclaimed himself Mahárája at Attock in July, 1845. Sardár Chattar Singh marched against him; the rebellion collapsed, and Peshora Singh was secretly put to death by order of Jowáhir Singh. No sooner had the news reached Lahore than the military committees resolved that Jowáhir Singh must die as a traitor to the Khálsa. The murder of Peshora Singh was distasteful to the soldiers, who venerated the memory of the great Mahárája, and the rivals of Jowáhir Singh, chief of whom was Lál Singh, fomented the ill-feeling. On the 21st September, 1845, Jowáhir Singh was accordingly summoned to appear before the Khálsa and answer for his misdeeds. He went, accompanied by the Ráni and the young Mahárája. The latter were removed, and Jowáhir Singh was then executed by the troops. The act was carried out with the deliberation and calmness that attend a judicial proceeding. For some time after the death of Jowáhir Singh no one seemed willing to become the supreme authority in the State. Rája Guláb Singh was urged to take the office of Wazír, but he and all others were overawed, and the Ráni herself for some time carried on the government, the troops actually putting up the appointment of Chief Minister to auction. The need of a responsible head was, nevertheless, apparent; and as the soldiers were by degrees being wrought upon to wage war with the English, Lál Singh was nominated Wazír, and Rája Tej Singh, brother of Jamadár Khúshál Singh, confirmed as Commander-in-Chief in November, 1845. There appeared, however, to be no hope that the troops would permit this arrangement to be more lasting than its predecessors; as a desperate resource, therefore, in order to turn the thoughts of the turbulent Khálsa in another direction, the Ráni and her party appear to have originated the proposal of a campaign across the Sutlej, which they earnestly expected would terminate with the destruction of the army.

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Meanwhile the British Government had for some time been aware that there could be but one end to the tragedy being enacted at Lahore, and that was war with the English. Troops were therefore quietly being massed on the North-west Frontier, especially at Ferozepore; while early in December, 1845, the Governor-General joined the Commander-in-Chief at Umballa. The attitude of the Government during this period of anticipation was, however, entirely pacific, and the English stood on the defensive till attacked by the Sikhs. On the 17th November, 1845, the pancháyats of the Khálsa made up their minds for war; the resolution was approved by the Darbár; and after a solemn meeting of the deputations and the commanders at Ranjít Singh's tomb, the Sikh army, consisting of about 60,000 men with 150 guns, was set in motion towards the British frontier. The details of the campaign are sufficiently known. On the 18th December, 1845, the first action was fought at Múdki; three days afterwards followed the toughly-contested battle of Ferozeshahr; on the 22nd January, 1846, the Sikhs were defeated at Alíwál; and lastly, on the 10th February, 1846, the entrenched position of the Khálsa at Sobraon, on the left bank of the Sutlej,

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was taken with great loss to the Sikhs. All resistance was now at an end. The victorious British army marched unopposed to Lahore, which was occupied on the 22nd of February. Briefly, the terms made were: the cession in full sovereignty to the British Government of the territory lying between the Sutlej and Beas rivers; and a war indemnity of one and a half crores of rupees. As the Darbár was unable to pay the whole of this sum, or to give satisfactory security as an equivalent to payment of one crore of rupees, the cession was arranged of all the hill country between the Beas and the Indus, including Kashmir and Hazára; the Darbár also engaged for the payment of the remaining fifty lakhs of rupees; the disbandment of the Lahore army and its re-organization, upon a fixed scale not to be exceeded without the sanction of the British Government; the cession of the entire regulation and control of both banks of the Sutlej; a free passage through Sikh territory for British troops whenever required; the recognition of the independent sovereignty of Rája Guláb Singh; and lastly that the limits of Lahore territory should not be changed without the concurrence of the British Government. In addition, at the request of the Lahore Government, it was settled that a British force should remain at Lahore for a time to assist in the re-constitution of a satisfactory administration. Simultaneously, a treaty was executed with Maháràja Guláb Singh of Jummoo, by which the English made over to him, in independent possession, the hill country ceded by the Lahore Darbár, lying east of the Indus and west of the River Ravi, in consideration of a payment of seventy-five lakhs of rupees, and subject to the conditions of not changing the limits of his territories without the consent of the British Government; of assisting it when at war in the countries adjoining his possession, and of ackowledging the supremacy of the British Government. At Lahore, Major Henry Lawrence remained in charge of political relations with the Darbár, of which *Lál Singh* was appointed the chief. Shortly afterwards the Governor of Kashmir resisted the transfer of his province to Mahárája Guláb Singh by force of arms, and pleaded the orders of Lál Singh in justification of his resistance. It was fully established at a public enquiry that this was the case; Lál Singh was deposed and exiled to British India, and, at the solicitation of the Darbár, a fresh treaty was concluded in December, 1846, by which, during the minority of Mahárája *Dalíp* Singh, a British officer with a staff of assistants was appointed with full authority to direct and control all matters in every department of the State, which were to be carried on by a Council of Regency, its members to be fixed by the Governor-General. Further, a British force was to remain at Lahore, at the expense of the Darbár, and the British were to be at liberty to occupy any fort or position they thought advisable in the Sikh dominions. The arrangements indicated above were to terminate on the Mahárája attaining 16 years, on the 4th of September, 1854, or earlier, at the option of the Governor-General.

Second Punjab Campaign.

For a time the work of re-organizing the shattered government of the country proceeded quietly and with every prospect of success. The invigorating influence of British officers was everywhere per-

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ceptible. But it was improbable that the Khálsa would submit without one more blow for the power they had lost. The villages were filled with soldiers belonging to the disbanded army who were only waiting for a signal and a leader to rise in arms. There were also many minor causes for discontent; kine-killing was no longer allowed to be a crime, and the hated Muhammadans, who were under Sikh rule a persecuted race, now held up their heads; the people at large, too, believed that the English never intended to leave the Punjab. There was thus plenty of material for rebellion ready at hand. Intrigues were rife, and an accidental collision sufficed to set the Punjab in a blaze. Two British officers were deputed in April, 1848, to Mooltan, in order to assist the new Sikh Governor of the place who had replaced Diwán Múlráj, son of the famous Diwán Sáwan Mál. On the 19th April, Mr. Vans Agnew and Lieutenant Anderson were wounded by the Diwán's troops while Múlráj was showing them the fort of Mooltan. Next day they were killed, being deserted by their Sikh escort. There is no reason to believe that the first attack was made by the orders of the Diwán or that it was anything but the sudden outburst of fanaticism. But, blood having been shed, Múlráj and his followers knew they could not retrace their steps, and considered rebellion would be a lesser evil than submission. Múlráj at once prepared for a siege, issued a proclamation calling upon all true Sikhs to rise against the British, and sent urgent appeals to all the leading Sardárs of the Khálsa. The mother of the young Mahárája was, also, about this time convicted of treasonable correspondence and removed to Benares. There was some delay in operating against Mooltan, which was, however, gallantly invested in the meantime by frontier levies raised by Lieutenant Edwardes and the Baháwalpur troops under the command of Lieutenant Lake. In June, 1848, Sardár Sher Singh, son of Sardár Chattar Singh, Atáríwála, was sent with 5,000 Sikh troops to co-operate with Lieutenants Edwardes and Lake. A British force under General Whish followed him in August. At this time Sardár Chattar Singh, Atáríwála, himself was Governor of Hazára. His troops were notoriously mutinous, but he gave no notice to the British authorities of the disaffection, which he shared and which he himself encouraged. On the 6th of August the Hazára troops mutinied. On the 19th August the news of this event reached Sardár Sher Singh at Mooltan, and on the 13th September he and his force went over to the enemy. The defection of Sher Singh compelled General Whish to raise the siege of Mooltan. There were now two centres of rebellion, whence issued fiery calls to the Khálsa to expel the English from the country. In October, Sher Singh moved off to join his father, Chattar Singh, who meanwhile had taken Attock, invoked the aid of the Amír Dost Muhammad Khán, and marched towards the Jhelum to join his son, collecting insurgents as he went. The Amír responded by seizing Pesháwar and sending an Afghán contingent to join Chattar Singh. In October the British army had crossed the Sutlej; proceeding from Ferozepore across the Punjab at an angle to the Sikh line of march, it came up with Sher Singh at Rámnagar on the 2nd of November, and there inflicted on him a

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severe check. The Sikh army, consisting of 30,000 men and 60 guns, made a stand at Chiliánwála, where on the 13th January, 1849, an indecisive and most sanguinary battle was fought. Two or three days after the action Sardár Chattar Singh joined Sher Singh's camp, bringing with him a thousand Afghán horse and Sikh reinforcements. The Commander-in-Chief awaited the arrival of the column under General Whish, which had been set free by the fall of Mooltan, and then followed the Sikhs from Chiliánwála to Gujrát. Here, on the 22nd of February, 1849, the last and decisive battle was fought, and the Sikh kingdom came to an end. The Sikhs were totally defeated, losing 55 guns; Pesháwar saw for the last time an Afghán garrison within its walls; the remnants of the Sikh army and the rebel Sardárs surrendered at Ráwalpindi on the 14th March, 1848, and henceforth the Punjab became a Province of British India.

Annexation of the Punjab.

The Punjab was formally annexed by a proclamation on the 29th March, 1849, on which day terms were granted to and accepted by Mahárája Dalíp Singh. He resigned the sovereignty of the Punjab, receiving a pension from the British Government, and now resides permanently in England.* Steps were immediately taken to pacify the country. All forts, except those required for military or political purposes, were dismantled. A general muster was called of the Sikh soldiery together with all military retainers of the late Government and its Chiefs. The men were chiefly collected at Lahore and there paid up and disbanded, while the most promising of them were taken into the British service. All those who could not be admitted received gratuities and pensions; and the infirm and the superannuated were also pensioned. The process of reduction of the Sikh army was thus quietly accomplished, and while employment was found for adventurous spirits, care was taken to avoid flooding the country with needy and desperate men.

Form of Administration adopted.

The British Government was now called upon to provide a new administration which should adapt itself to a mixed people and manage a warlike and stubborn class who had just been deprived of power. Order had literally to be evoked out of chaos. It was necessary that the people should be induced loyally to accept the change of government; old prejudices and customs had to be removed, and new laws and restrictions had to be introduced. This revolution was peacefully accomplished without a single riot or outbreak, although a large disbanded army had mingled with the people, when many adherents and servants of the Sikh Government were wandering unemployed about the country, and when the most influential section of the population was still animated with a feeling of nationality, of revenge against the conquerors, and of dislike to a change of institutions. In view of the peril which befell the British Empire in India only eight years after annexation of the Punjab, the experiment was a hazardous one. That the measures succeeded, and that the Punjab, instead of a source of danger, proved to be the mainstay of the English power in Upper India

* After the above was written, he threw up his pension, was stopped at Aden by the orders of Government on an attempt to visit India, and eventually took up his residence in Russia.

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during the Mutiny, is to a great degree due to the sagacious and prudent manner in which the task of governing the newly-acquired territory was carried out by the men in whose hands Lord Dalhousie placed the trust. At the head of affairs was placed a Board of Administration consisting of three members, who, although acting jointly in matters of importance, took each a special charge of one of the functions of the Board, divided under the heads of political, revenue and judicial. The whole Province was divided into seven divisions, administered by Commissioners who corresponded direct with the Board; two divisions comprised the Sikh territories acquired before and at the first Sikh War; and the remaining five included the Punjab trans-Sutlej. For a short time the present districts of Peshâwar, Kohát and Hazára were under the direct control of the Board, but about the year 1850 they were formed into a separate division. The divisions were subdivided into twenty-seven districts in charge of Deputy Commissioners, who were provided with a staff of Covenanted Assistant Commissioners and Uncovenanted Extra Assistant Commissioners. The districts again were divided into *táhsíls* or sub-divisions for the collection of revenue, and police circles. The Board was entrusted with plenary authority to control and supervise all Departments. The Commissioners were to be Superintendents of revenue and police and to exercise the civil appellate and the criminal original powers of a Sessions Judge. The Deputy Commissioners were given subordinate civil, criminal and fiscal powers; combining in one person the different aspects of the administration, and thereby much increasing its vigour.

Laws framed and other measures introduced.

The first object of attention was to place the revenue system on a sound basis. Settlements made during the regency of the Resident were upheld as temporary measures, and in tracts that had not been previously settled summary settlements to last five years were made, pending the introduction of regular settlements which would endure for from fifteen to thirty years. In the Civil Courts the rules current in the Sutlej Divisions were at first observed, as they were calculated to ensure substantial justice unfettered by technicalities. Subsequently, a Punjab Code, embodying much of the customary Civil Law of the Province, was prepared. In Criminal Law, the Code adopted during the period of the residency was maintained. One of the principal duties of the new Government was to develop the resources of the country, to make canals, and, chief of all, to create roads; the latter did not exist, from a civilized point of view, in the country when it was taken over. The principal and earliest work of this kind that was undertaken was the construction of the Grand Trunk Road to connect Peshâwar with Lahore. The Bári Doab Canal was commenced, and many other works of public utility were either projected or undertaken. A strong body of military police under European military officers, comprising six regiments of foot and twenty-six troops of horse, in all 8,100 strong, was raised in aid of the civil police, the establishment of which was of the strength of 6,900 men of all grades. The military police furnished guards and patrolled the country, and acted in the prevention of crime and

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apprehension of offenders, while the civil police, who were under the charge of the civil officers, were entrusted with the detection and prosecution of criminals, and the duties of watch and ward in towns and villages. In connection with the police, a measure may be mentioned which very materially led to the speedy pacification of the country and its subsequent tranquillity, *viz.*, the general disarmament of that part of the Province lying between the Indus and the Sutlej. (The Cis-Sutlej Divisions and the territory round Delhi were disarmed at a later date). It was carried out quietly and systematically without creating any serious annoyance. In all 119,700 arms of all descriptions were seized or surrendered. The sale, possession or manufacture of arms and ammunition, except in the trans-Indus tracts, was prohibited. In the frontier districts it was of course necessary to leave the people armed, in order to enable them to cope with their marauding neighbours of independent territory. With regard to these, special military measures were undertaken. The forts at the principal stations were repaired or rebuilt upon more scientific principles, a chain of fortified border posts was dotted along the whole length of the border line, parallel to which a military road was made with cross branches connecting it with the internal net-work of communications being established in the Province. A special force, the Punjab Frontier Force, under the direct orders of the Board, was raised for service, normally on the frontier, and only in special cases elsewhere. It consisted, at first, of five regiments of cavalry, the Corps of Guides, five regiments of infantry, three light field batteries, two garrison batteries, two companies of Sappers and Miners, and the Sind Camel Corps. Mule batteries have since been entertained in the Frontier Force, and the field batteries have been abolished; the Sappers and Miners have been withdrawn, and a Gurkha regiment has been added to the force. A few years after annexation the Camel Corps was changed into a regiment of infantry.

The work of reclaiming the country, of civilizing its people, and of developing its resources, was carried on without interruption for the next seven years. The Punjab became gradually covered with the institutions of modern civilization; roads were made in every direction; canals were projected or constructed; schools, dispensaries and jails were erected in every district; a uniform Code of Civil and Criminal Law and Procedure was adopted; the currency was reformed; taxation on trade was removed; and a system of regular settlements was commenced, which was designed ultimately to embrace the whole Province, and in the course of which the *status* of all classes connected with land, the shares of the produce one class could demand from the other, and the portion which was due to Government, were accurately defined and recorded.

Appointment of a Chief Commissioner.

It will be sufficient to notice briefly the principal occurrences connected with the internal history of the Province, reserving for subsequent paragraphs a short account of events on the frontier relating to the border tribes and Afghánistán, from annexation up to the present year. In 1853 the Board of Administration was abolished, and in its place Sir John Lawrence was appointed the first Chief Commissioner, as the head of the local executive administration,

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with control over the Punjab Frontier Force. Subordinate to him were appointed a Judicial and a Financial Commissioner, who were the chief authorities in the Judicial and Revenue Departments respectively. The Judicial Commissioner was also head of the Police: he supervised educational operations and superintended the control of Local and Municipal Funds. Among other measures, the following are principally noticeable as having been carried out during 1853: The addition of another battalion to the military police, raising it to a strength of seven battalions of infantry and twenty-seven troops of horse; the virtual extermination of Thaggi, and the employment as organized bodies of labourers of the Mazbi Sikhs, among whom this crime was prevalent; the introduction, or rather re-imposition, of octroi duties in all towns and large villages in lieu of a house-tax, with the full preference of the inhabitants; the determined effort to put down female infanticide which found expression at a great assembly of all the leading Chiefs and Native gentlemen of the Province at Amritsar, when rules with a view to diminishing marriage expenses were accepted by those present and promulgated for general observance, and, lastly, the introduction of tea cultivation in the Kángra District, and extensive operations in arboriculture, nearly a million trees being planted in two districts alone. Including all the necessarily large expenditure consequent upon the annexation of a Province in the condition in which the Punjab was found to be when taken over, the financial results of the administration shewed a surplus in 1851-52 of seventy-three lakhs of rupees, and in 1852-53 of thirty-five and three-quarter lakhs.

The Sepoy Mutiny.

The next three years from 1853 to the close of 1856 constitute a period of consolidation, during which the measures originated in the earlier years were completed or perfected. No events in the internal history of the Province call for special notice, except that the construction of a railway from Mooltan to Amritsar was under consideration, when the outbreak of the Mutiny put aside, for a time, that and many other schemes for the improvement of the country. On Sunday, the 10th of May, 1857, the sepoys at Meerut mutinied, plundered the station, and marched to Delhi, where they were joined by their comrades of the garrison; next day the old Moghal King, Bahádur Sháh, who was residing there as a pensioner of the British Government, was proclaimed as their sovereign by the mutinous troops, all Europeans who could be caught were butchered, and the true character of the revolt was thus declared. There were at this time in the Punjab the following troops: Hindústánís 35,000 men, Punjabi irregulars 13,000, Europeans 10,000 men; there were also 9,000 military police, among whom was a certain number of Hindústánís. The Europeans consisted of twelve regiments, of whom no less than seven were either at Peshâwar or in the hills north of Umballa, leaving only five regiments to hold the country from the Indus to the Sutlej. The news of the massacre at Delhi reached Lahore on the 12th of May. The Chief Commissioner was absent at Ráwalpindi, and Mr. (now Sir R.) Montgomery was the chief civil officer present. There had not been wanting premonitory signs that the sepoys were disaffected and likely to rise, and it was clear to all that immediate action must be taken. The civil and military

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authorities decided at once what should be done, and on the 13th May 3,000 native troops were successfully disarmed at Meean Meer. At the same time European troops were thrown into the forts of Govindgarh and Phillour, the first important as commanding Amritsar, the second as containing a large arsenal from which subsequently were served the munitions of war for taking Delhi. On the 14th May the arsenal at Ferozepore was secured; the sepoys here mutinied on the following day and escaped without punishment. On the 21st of the same month the 55th Native Infantry rose at Mardán and fled to independent territory; many were killed in pursuit, and the remainder were destroyed by the hillmen. On the 7th and 8th of June the native troops at Jullundur broke and escaped to Delhi. In the first week of July the sepoys at Jhelum and Siálkot mutinied; they were destroyed, as were the 26th Native Infantry, who rose at Lahore on the 30th July, and the 51st Native Infantry, who mutinied at Pesháwar on the 28th August. Simultaneously, with the vigorous suppression of mutiny, 13,000 native troops were disarmed without resistance during June and July. This large body of men was kept under a strict watch at different stations in the Province, proving a very inconvenient charge at a time when the Punjab was denuded of troops. While the Hindústáni troops were thus being disposed of, the despatch of reinforcements to Delhi, an object of paramount importance, proceeded without a break. About the 17th of May it had become apparent that the Punjab did not sympathise with the movement in Hindústán and that a good spirit prevailed in the Punjabi troops. It was therefore safe to augment them; and it may be mentioned here that eighteen new regiments were raised in the Province, five in May and June, eight in August, and the remainder during the later months of the year. As these forces were being entertained to supply the place of those who marched down to Delhi, the stream of reinforcements was steadily maintained. Four regiments from the European garrison of the Punjab formed the greater portion of the European force that first marched upon Delhi. Next followed two wings of European regiments of infantry. Then a considerable force of native troops was despatched, including the Guides, two regiments of Punjab Cavalry, a body of Punjab horse, two regiments of Punjab Infantry, and a body of 1,200 Pioneers raised from the Mazbi Sikhs; 7,000 men, forming the contingent of the Cis-Sutlej Chiefs of Patiála, Jínd and Nábha, accompanied the regular troops to the siege of Delhi. It was on this occasion that the Guide Corps performed their memorable march of 580 miles in 21 days from Mardán to Delhi, where they arrived early in June, the first of the Punjabi troops. In the steps of the reinforcements mentioned above, an irregular force of 1,000 men was detached to clear the western part of the Delhi territory. Waggon trains were organized from Mooltan and Ferozepore *viá* Umballa to Delhi. Siege trains, treasure, stores and transport animals were poured down from the Punjab for the besieging force. Finally in August one last effort had to be made to send reinforcements. There were then in the Punjab 6,000 armed and 12,000 disarmed Hindústáni sepoys, and 6,200 European soldiers,

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of whom nearly one-half were locked up in the Pesháwar Valley, and the greater part of the rest employed in guarding the disarmed troops. The need for aiding the force at Delhi was, however, imperative; it was therefore resolved, in spite of the grave risk thereby incurred, to send Brigadier-General John Nicholson with the movable column (which had destroyed the Siálkot mutineers) and every European who could be spared. Two half regiments of European Infantry, the 52nd Foot (belonging to the movable column) and three regiments of Punjab Infantry were despatched. These were followed by a siege train from Ferozepore, a wing of the 1st Bilúch Regiment arrived from Sind, and a contingent 2,000 strong from the Mahárája of Kashmir. There then remained only 4,500 Europeans (including sick) to hold the Punjab. The crisis had now come. If Delhi were taken speedily, all was well; if Delhi were not taken without delay, there would be a struggle for European dominion and existence in the Punjab itself. The most ignorant of the Punjab people had realized the danger to the British Empire; the least observant knew that the resources of the British Government in this Province were exhausted. The next few weeks after the departure of Nicholson's column were weeks of anxious suspense, in which all eyes were turned to Delhi. The tension became extreme. The first symptoms of the wavering faith of the people in the British power appeared in local outbreaks at Murree in the north and in the wild and barren tracts south of Lahore, between the Ravi and Sutlej. Both were, however, soon put down, and the fall of Delhi on the 14th September put an end to all further cause for apprehension. The first sign that the mass of the inhabitants had regained confidence was that the Sikhs of the Mánja, or the tract between the Ravi and the Sutlej rivers, came forward for enlistment in the new levies. Hitherto they had held aloof. Exertions to reinforce the army in the field and to make up their losses by sickness and death were not relaxed after the capture of Delhi. On the 1st of May, 1858, the aggregate number of Punjabi troops amounted to 58,000 men, of whom 35,000 had been entertained since the commencement of the Mutiny; and of the total number 12,000 men were in the field in Hindústán.

Measures taken for the tranquillity of the Province.

It remains now to notice briefly the subsidiary measures in aid of the military operations for the suppression or prevention of the mutiny in the Province, and to state the causes why the Punjab people and army resisted so long the tendency to rebellion. As regards the first, civil officers were immediately empowered to try and punish summarily, even with death, offences affecting the public tranquillity; a strict but judicious censorship was maintained over the native press; all letters addressed to sepoys were opened, and much curious and valuable information was thereby obtained. All treasure was concentrated at places where a European guard could be obtained. The ferries over the five great rivers of the Punjab were guarded with special care, and the country was thus divided into blocks of territory insulated from each other. All Hindústánís without employment were deported out of the Punjab, and mendicants and roving fakírs coming from the east were turned back.

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The tracts known as the cis and trans-Sutlej divisions, those parts of the Punjab that lie east and south of the Beas and Sutlej, were disarmed, 69,000 stand-of-arms being given up by the people. These divisions had not been included in the disarmament of the rest of the Punjab which took place in 1849. A few months later the Delhi and Hissar Divisions were also disarmed, 225,000 arms being taken by the police in addition to forty cart-loads of arms from the city of Delhi. The principle of recovering the value of plundered property from the persons, villages or towns implicated, by means of fines, was everywhere rigidly enforced. Lastly, the active co-operation of the people in the extirpation of the mutineers was secured by paying a reward of Rs. 50 for every mutinous sepoy delivered up alive, the captors being permitted to retain any property found on the person of the mutineer. The effect of this order was to place the Hindústánís as soon as they left cantonments among a nation of enemies. The financial position of the Province was a difficult one; all remittances from Calcutta were cut off, the demands of the besieging army before Delhi were large, and it took some time for money from Bombay to reach Lahore. A loan, producing 41 lakhs of rupees, was therefore raised: it served as a useful index to the state of public opinion. The attitude of the Native Chiefs dependent on the Punjab throughout the crisis was excellent. The Rája of Jínd was actually the first man, European or Native, who took the field against the mutineers, and his contingent collected supplies in advance of the English troops moving upon Delhi. The contingents furnished by other Chiefs have been mentioned above. With the exception of the Nawáb of Baháwalpur, who did not stir, every Chief in the Province, as far as he could, aided the English in preserving order and in suppressing rebellion. There can be no doubt that the action of the Chiefs had an important bearing on keeping the population steady.

Abstention of the Punjabis from the rising of 1857.

The causes to which may be ascribed the general abstention of the people from the rising of 1857 are as follows: In the first place, the country had been recently conquered and the memory of the English victories was still fresh. The Punjab is inhabited by antagonistic races between whom differences of religion have placed a deep and broad gulf; the Muhammadans naturally sympathised with the attempt to revive a Mughal supremacy, but dreaded the power of the Sikhs should the controlling hand of the British be withdrawn; the Sikhs for their part viewed with antipathy everything connected with the Delhi kings; both Sikhs and Muhammadans of the Punjab disliked the Hindústánís; the vigorous acts of the authorities in May and June, 1857, led the people to believe that the Mutiny would be easily overcome; at any rate, they knew that the Punjab would not be given up for some time, and they sided with the power of the day. Trade was flourishing, and general prosperity and comfort prevailed owing to good harvests. There was no general desire for change; on the contrary, the incidence of revenue being light, and the people being contented, a reversion to the old order of things was not desired. The people had been disarmed and were taking to peaceful pursuits. The wild and adventurous spirits were absorbed in

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the forces that were enlisted, and the march upon Delhi was a popular expedition. The Chiefs and leading men had been kindly treated and were unwilling to see the present Government make place for the anarchy which was sure to follow. Moreover, there was no person in the Punjab who could command the allegiance of the masses. And when they did come to think that British supremacy in India might come to an end, and when the popular mind was drifting into disaffection, the fall of Delhi removed their doubts regarding the stability of British rule, and they became again loyal subjects.

Events subsequent to the Mutiny.

The next few years after the Mutiny were devoted to restoring order and to taking up the task of progress which had been temporarily suspended. In February, 1858, the Divisions of Delhi and Hissar were formally incorporated in the Province of the Punjab. In August of this year two disarmed native regiments at Mooltan revolted owing to misapprehensions of the intention of Government towards them. They were pursued and all of them either captured or killed. This was the last outburst of the mutinous spirit in the native army. The Hindústání regiments that were disbanded at Meean Meer and elsewhere were sent to their homes. Other military measures were the transfer to the Bengal Army of four regiments of cavalry and seventeen of infantry raised in the Punjab during the Mutiny. A regiment of Gurkhas was formed from men of this class in the Punjab Infantry and the Police Battalions, and added to the Punjab Frontier Force. Rewards in the shape of grants of territory were made to the Chiefs of Patiála, Jínd and Nábha for the services rendered during the preceding year; and a large estate in Oudh was conferred upon the Rája of Kapurthala. At the commencement of 1859 the Punjab together with the Delhi territory was placed under a separate Lieutenant-Governor. Sir John Lawrence was the first to hold the office; after a brief interval he resigned and left the Province, with the administration of which he was so intimately connected ever since its annexation to the British Empire, and was succeeded by Sir R. Montgomery. The year is remarkable for the commencement of the first railway in the Punjab from Amritsar to Mooltan (on the 8th February, 1859), and for the admission of water into the Bári Doáb Canal. The year 1860 is marked by a severe famine which afflicted the districts south of the Sutlej. Efforts were made to relieve the starving population, but there was great mortality. The districts along the Rájpútána border felt the effects of the famine most severely. The following years demand little remark on account of events of special importance; the resources of the country were quietly developed, and steady progress made in every branch of the Administration. In 1860-61 the Police were re-formed, the military and civil branches of this force were amalgamated and placed under the orders of an Inspector-General. In 1862 the Penal Code was introduced in the Punjab. During these two years much was done to assimilate the government of the Punjab to that of the older Provinces of British India. Special courts for the trial of civil suits were established, civil and criminal jurisdiction was conferred on some of the principal jágírdárs as Honorary Magistrates, taxation was imposed on the non-agricultural classes,

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and the land-revenue system was framed on that of the North-Western Provinces. The conservation of the timber forests on the slopes of the Himalayas was taken in hand, the preliminary surveys and reports being made in 1861-62. Some excitement was caused in 1863 by the discovery of a conspiracy for supplying the colony of Hindústání Wahábís at Malka on the Mahában range in independent territory west of the Indus, where it enters the Pesháwar District, with men, money and ammunition from Bengal and Hindústán. The principal despatching agency was at Patna, while a regular chain of posts thence to the Indus gave to recruits opportunities for being passed on, and to the faithful generally the means for the transmission of their subscriptions towards defraying the expenses of the Malka colony, which was understood to be the nucleus for a holy war when the proper moment came. The principal ringleaders were seized, tried at Umballa, and sentenced to transportation for life. The Ambela expedition, of which a short account will be found below, was undertaken with the object of destroying Malka. The first Exhibition of Arts and Manufactures, in the Punjab, was held at Lahore in this year. On the 10th January, 1865, Sir R. Montgomery resigned the Lieutenant-Governorship of the Province, and was succeeded by Sir D. McLeod. In the same year the office of Judicial Commissioner was abolished, and a Chief Court, consisting of two Judges, was created by Act XXIII of 1865.

Noteworthy incidents during past 17 years.

Henceforth the internal history of the Province is practically that of the remainder of British India; and there is little of special and distinct interest to record. In 1865, disturbances in Baháwalpur and the simultaneous death of the Nawáb compelled the interference of Government, and the State was placed under the care of a Superintendent. In 1867 special efforts were made to develop the trade with Yarkand and Kashgar. The eastern and southern parts of the Province were visited by a severe drought in 1868-69, which culminated in a famine in the tracts to the south of the Sutlej. Relief works were promptly undertaken in the Jullundur, Lahore, Hissar and Delhi Divisions, in the two latter on an extensive scale, the number of persons that received relief in these Divisions from January to May, 1869, being 2,100,000. Rain fell in March, 1869, and for a time matters looked better, but the rainfall throughout 1869-70 was unseasonable, and the drought continued with increasing severity. But for a copious fall of rain in September a famine more terrible than the famine of 1783, which is still remembered, would have devastated the country. Owing, however, to the timely adoption of further measures of relief, the exertions of all officers and the co-operation of the wealthier classes, the people were saved from death, and were subsequently helped to recover from the calamity by advances of money and liberal remissions of revenue. The famine was, as usual, attended by sickness. Smallpox and cholera prevailed to an alarming extent during the year. In 1869 a third Judge was added to the Chief Court. In June, 1870, Sir D. McLeod retired from the office of Lieutenant-Governor and was succeeded by Sir H. Durand, who however met with a fatal accident

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seven months afterwards. His successor was Mr. (now Sir H.) Davies. The year 1871-72 was one of considerable legislative activity for the Punjab. The provisions contained in the Punjab Civil Code and in various Bengal Regulations, and administrative rules and orders were consolidated aud re-enacted in the Punjab Laws Act. An Act was passed for the collection and settlement of the land-revenue. The Punjab Local Rates Act provided local funds for public purposes in districts; while the Canal and Drainage Act codified the rules regarding irrigation in the Province. Special legislation was adopted to control the criminal tribes which are found in some strength in the Punjab. Special regulations were also passed for the frontier districts, giving District Officers additional powers for the suppression of crime and for punitive measures against hostile frontier tribes. The Police Act was also extended to the Pesháwar and Deraját Divisions, Commissioners being appointed *ex-officio* Inspectors-General of Police within their divisions. Lastly, it may be mentioned that the experiment of employing prisoners on extra-mural labour at Rúpar on the Sirhind canal work was commenced in this year. In January, 1872, a band of Kúka fanatics caused a disturbance in Maler Kotla, which had been preceded by the murder of some Muhammadan butchers at Amritsar in August, 1871. Repressive measures were promptly taken, and the ringleaders were exiled. In 1874-75 the first step was taken towards the separation of the judicial and executive functions, which, as explained above, had been combined in the persons of District Officers ever since annexation of the Province. Separate Courts for the disposal of civil suits were established in every district. In January, 1876, His Royal Highness the Prince of Wales paid a visit to the Punjab. The year 1877 was marked by the Imperial Assemblage, and the gathering of all the Punjab feudatories at Delhi, in common with the other Chiefs of India. Unseasonable weather in 1877-78 caused considerable anxiety. A scarcity was experienced in the districts of Hazára, Karnál, Hissar and Delhi, where special measures of relief had to be organized and works had to be undertaken for the relief of the starving population. In April, 1877, Mr. (now Sir R.) Egerton succeeded Sir H. Davies as Lieutenant-Governor of the Punjab. In November, 1878, the war with Amír Sher Ali Khán commenced. The resources of the Province were fully taxed, as it formed practically the base of operations for the armies operating in Northern Afgháuistán. In the earlier phase of the war contingents from the States of Patiála, Baháwalpur, Jínd, Nábha, Kapurthala, Farídkot and Náhan joined the British forces and performed excellent service. The years during which the war lasted, from November, 1878, to the end of 1880, were years of some scarcity, owing to deficient rainfall; there was considerable sickness, and trade towards the west was affected by the war; but the operations in the field called everywhere for increased labour, high profits were made by many sections of the community, and the simultaneous construction of the railway towards Kohát and Pesháwar, which was pushed forward with much energy, afforded ample employment

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to the needy; and the result of all these causes was the general prosperity of the people. With the close of the war the progress of the Province has resumed its normal course, which has proceeded without interruption. The most important features of this period are, in November, 1882, the opening of the Sirhind Canal, which is destined to irrigate a vast extent of country, and in June of the same year the completion of direct railway communication with Peshávar. In 1881 a fourth and in 1882 a fifth Judge were temporarily added to the Chief Court. The minor events of past years will be found in detail in the Administration Reports. In April, 1882, Sir R. Egerton made over charge of the office of Lieutenant-Governor to Sir C. U. Aitchison.*

Frontier Tribes.

A slight sketch of the relations of the British Government with the frontier tribes remains to complete this brief account of the recent history of the Punjab. The English first came into contact with the Afgháns, in their native country, on the occasions of the missions of Elphinstone to Pesháwar in 1807 and of Burnes and his companions to Kabul twenty years afterwards. So far, the intercourse had been friendly; and, if there was no special liking on either side for the other, there was at any rate no aversion or distrust, and British officers could travel over all parts of Afghánistán in perfect safety. The unfortunate occupation of the country from 1839 to 1841, in a vain attempt to restore the Saddozai dynasty, effected a lasting change in the feelings of the Afgháns towards the English. The events of the first Afghán War are foreign to the present historical summary. It is enough to say that, though at the beginning there was a party among the Afgháns which sided against the Barakzai rulers of Kabul and Kandahár, and although it is not impossible that, if the British army had been withdrawn after the surrender of Dost Muhammad, Sháh Shúja might, had he been equal to the effort, have maintained himself on the throne; yet the prospect, as the Afgháns believed, of the permanent retention of British troops roused their fanaticism and their national spirit, led them to make a determined attempt to regain their independence, and left a national inheritance of hatred and distrust of foreign invaders. After the withdrawal of British troops in 1841, Sikh and Afghán carried on the intermittent warfare along the border of the Sikh possessions, which had been prosecuted with savage ruthlessness on both sides since the first advance of Ranjít Singh on Pesháwar. In their need, the Sikh rebels of 1849 made terms with the Amír, and the strange sight was seen at Gujrát of hereditary enemies fighting side by side against the English. With the annexation of the Punjab a new order of things was introduced on the frontier. The Sikh method of administering these turbulent tribes had been of the loosest description. Strong forces were maintained at the head-quarters of districts, round which a semblance of authority existed; next followed a belt of country owning a doubtful allegiance, and paying revenue at uncertain intervals under compulsion; at a further distance from the garrisons

* Since the above was written (in April, 1887) Sir Chas. Aitchison has been succeeded by Mr. J. B. Lyall.

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the shadowy power of the Sikh governors faded away till it was difficult to say whether the villages were independent or not; and lastly came the tribes who openly asserted their independence. The Sikhs looked mainly to the realization of the revenue; for the rest, the population conducted matters in their own way and retained their own wild laws and relations with their neighbours in the hills. When the frontier was taken over in 1849, law and order were introduced with comparatively little difficulty in the new possessions, and in only a few instances, which are detailed below, has it become necessary to move troops for the coercion of British subjects on the frontier. No doubt the previous handling the people had received from the Sikhs had considerably broken their stubborn spirits and induced them more readily to conform to the demands of their new rulers. The case was otherwise with the men of independent territory. Between them and the settled tracts of Sikh days there had intervened a kind of semi-debateable country, the residents of which, save for the periodical visits of the revenue-collecting Sikh armies, had been practically independent; with their sufferings at the hands of the hillmen the Sikhs had no concern, and they were free to retaliate as they pleased on their enemies. The dealings of the Sikhs with the residents of independent territory, when on an amicable footing, were conducted through the very doubtful medium of local middlemen. Moreover, the Sikh armies rarely, if ever, penetrated so far as to inflict punishment on the tribes in the hills. The latter consequently fancied themselves unconquerable and habitually considered the plains their prey, subject to the resistance of the villagers. With the arrival of the English, the margin of the settled country was pushed forward to the verge of the frontier line, and the incursions of the hillmen brought them at once into conflict with a Government whose resources and power they were quite unable to realize without the palpable lessons of retaliatory expeditions. Like all savages, they were extremely suspicious, grossly ignorant and utterly incapable of apprehending what was not brought visibly before their eyes, and it has been necessary to teach every clan in succession, sometimes more than once, by forcible means, that, while the British Government has no desire to subvert their independence, it insists that its territory and interest must be respected.

Pacification of the Frontier Tribes.

The following is a brief sketch of the measures that have been adopted from time to time for the reduction and pacification of the frontier tribes, and for the better defence of the border within British territory. In the majority of cases the military operations that have been undertaken are of the nature of petty border raids, and only a few can be dignified with the importance of a regular expedition. The military measures for the protection of the border taken in 1849, and involving the creation of the Punjab Frontier Force, and the construction of a chain of fortified posts, have been mentioned above. The frontier was disturbed in the years 1849 to 1851, in the north, by Mohmand marauders along the border of the Peshâwar District from the Swât to the Kabul rivers, and, in the south, by a sudden attack on the town of Dera Fatteh Khan

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by the Kasránís. Further incursions and raids followed in the next two years. The Sayads of Kághán, a remote glen of the Hazára District, refused to pay revenue in 1852, but speedily gave way before a show of force. In December, 1851, Messrs. Carne and Tapp, of the Salt Department, were cruelly murdered by Hassanzais, on the south-western border of Hazára, within the British boundary. A force subsequently entered the Hassanzai settlements on the Black Mountain, and exacted retribution. In the Pesháwar District the Mohmands continued to rob and plunder, led on by the Khán of Lálpúra, who had been hostile during the occupation of Afghánistán in 1839, and had been deposed; he regained his position on the departure of the British troops in 1841. Eventually, a force from Pesháwar destroyed the border villages of the Mohmands, and forts were built at Michni and Shabkadar to control them. Ultimately, they entered the district 6,000 strong, but were defeated with loss by a small detachment of British troops. They then made a temporary peace. In the Kohát District the tract of Míranzai, a narrow valley to the west of Kohát, was annexed in 1851 at the earnest entreaty of the inhabitants. The Wazíri and Shiráni tribes gave some annoyance on the Kohát and Bannu border, especially the former, who, in 1852, attacked the village of Bahádur Khel in order to plunder the salt mines. They were repulsed by the military police, and a fort was built at Bahádur Khel. Later in the year a successful raid was made on the Umarzai section of the Wazírs for this offence. Further south, the Bozdárs in force attacked a detachment of the 4th Punjab Cavalry at Vidor, near Dera Gházi Khan; but the villagers turned out and routed the marauders. In March, 1853, it was resolved to punish the Shiránis and Kasránís. The principal villages of these tribes were destroyed, and they received a salutary lesson, which had a marked effect on their future conduct. In 1853 the Afrídís of the Kohát and Jowáki passes also gave some trouble. After a time they gave in, agreeing to keep open the Kohát Pass for trade in consideration of a fixed allowance. In February, 1855, the Bassi Khel Afrídís made an unprovoked attack upon an officer who was encamped in British territory near their settlements. They were immediately blockaded from the Pesháwar District, and twice punished by attacks on their villages. After being excluded from British territory for a year, and after being heavily punished in the expeditions, they submitted and made amends for their conduct. In this year the behaviour of the Michni Mohmands led again to the destruction of their strongholds and to the confiscation of the jágírs they had hitherto enjoyed in the Pesháwar District. The Orakzais, on the border of the Kohát District, were punished for misconduct during the year; it was also found necessary to reduce the newly-annexed valley of Upper Míránzai and the Kabul Khel Wazírs. In 1855 relations with the Amír Dost Muhammad Khán were resumed, and in March, 1855, a treaty of friendship was concluded with him. In the light of the events of 1857 the establishment of cordial relations with the Amír, who had it in his power to have seriously endángered the British position trans-Indus during the Mutiny, was extremely fortunate. An arrangement was made in

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1856, by which the British Government agreed to assist the Amír against the Persians, with a monthly subsidy of a lakh of rupees, so long as it might appear to be necessary, a British mission being stationed at Kandahár. Throughout the crisis of 1857 the behaviour of the frontier tribes was excellent, and numbers flocked down to take service. It is doubtful how far these mountaineers perceived the gravity of the moment—at all events, they preferred to join in the taking of Delhi than to come into collision with the still intact forces which guarded the frontier. The wanton murder of Captain Meecham and raids by the Kabul Khel Wazírs in 1859 led to an expedition into their settlements, in the course of which this clan was punished and the murderers were hanged; shortly afterwards, in the spring of 1860, the Mahsúd Wazírs were punished in consequence of a bold raid on the town of Tánk. The British troops, repelling a resolute night attack on their camp by the Mahsúds, marched through the Wazíri country, and after some demur the Mahsúds accepted the terms of Government.

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In 1863 the Amír Dost Muhammad Khán died at Herat, and Afghánistan was almost immediately plunged into civil war. During this year took place the most important as yet of frontier complications. From pre-annexation days a colony of Hindústání fanatics, the relics of the party of Sayad Ahmad, the Wahábí (who has been mentioned above as holding the city of Pesháwar for a short time during the reign of Ranjít Singh), had lived at Sitána on the Indus river. They professed to be preparing for a holy war, and received money and recruits from Hindústán and Bengal. Their presence near the British border being objectionable, they were expelled from Sitána in 1858. They then moved to Malka, in the Mahában range, which flanks the north-eastern corner of the Pesháwar District. As the peace of the border had for some years been disturbed by their fanatical operations, it became necessary to eject them from that part of the country. A force of 5,000 men advanced in October, 1863, up the Ambela Pass with the intention of reaching Malka by a circuitous route. A temporary check converted what would have been an easy march to Malka and back into two months' severe fighting in the difficult country at the crest of the pass. The tribes had time to collect, and a large confederacy, numbering from 15,000 to 20,000 men, was opposed to the troops, the conflict causing much excitement on both sides of the Pesháwar border. By December, 1863, all opposition had been overcome, the combination was broken up, and Malka was destroyed. The Wahábís have retired to a village, called Palosi, higher up the Indus. The Mohmands took advantage of the Ambela campaign to enter the Pesháwar District in force, led by their Kháns. They were however easily defeated with loss. Since then they have settled down to peaceable relations with the British Government, which have been interrupted only by isolated acts of offence, the chief being the murder of Major Macdonald, Commandant of Fort Michni, in 1873, and an attack upon a survey party which penetrated into the Mohmand hills during the Afghán war. In both cases full punishment was inflicted upon the offending sections. The next four years after the Ambela

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campaign, from 1864 to 1868, were a period of almost unbroken tranquillity on the frontier. Incidentally, it may be observed that in August, 1868, Sher Ali Khán finally defeated his rivals, and became Amír of Afghánistán. In October, 1868, the unsettled condition of the Agror Valley, on the western border of the Hazára District, and the hostile attitude of the neighbouring independent tribes, terminating in an attack on the police post of Ughi in Agror, made it necessary to send a force for the punishment of the inhabitants of the Black Mountain range. This was done effectively with but trifling resistance. From 1869 to 1877 the only event of importance that requires mention is the definite adoption of the system of employing a frontier militia. During these years occasional outrages were committed, and clans were coerced by blockades or reprisals, but the affairs are relatively of so unimportant a nature that they do not need special notice. Reverting to the frontier militia, it will be easily understood that, under the state of things prevailing in the times of the Sikh occupation, the border villagers were compelled to constitute themselves into an efficient and well-armed militia for the purposes of self-protection. On the annexation of the Punjab, the introduction of the military measures for the defence of the border, which have been already detailed, to a great extent relieved the people of the task of defending themselves, with the consequent gradual decay of their former warlike habits. Now as militia and village levies on the frontier, from the nature of things, if well-armed and willing to act, are better adapted to resist sudden raids or to follow up bands of marauders than regular troops who move more slowly, and cannot be located in sufficient force in every village on the border line, it became clear that to put an end to petty annoyances at the hands of the hillmen, with some prospect of success and at a small cost, it was necessary to revive the martial instincts of the people, and to place in their hands weapons with which they might expect to cope successfully with their independent neighbours, whose great aim in life it is to obtain superior arms. In the year 1872-73 the frontier militia of the Deraját Division was re-formed and placed on a sound footing. To conclude this subject, it may be added that in 1878 measures creating a border police and militia were sanctioned for parts of the Pesháwar and Kohát districts, and that the remaining portion of the scheme for these districts is now in course of being carried out; when complete, the more exposed section of the north-western frontier will be guarded by a chain of posts held by natives of the spot, who will be supported by a strip of an armed population fringing the border line; and only as a last resource will it be necessary to call in the aid of the military forces, acting as a reserve for grave occasions. The procedure adopted at the annexation of the Province is thus reversed, the troops being placed in ordinary cases as a support of the villagers, and not in their van. From 1877 to 1881 the frontier was abnormally disturbed, as it was impossible that the strained relations of the British Government with the Amír Sher Ali Khán, and the war in Afghánistán, should not re-act upon the frontier tribes. Although they own no allegiance to Kabul, they could not resist their national

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and religious sympathies with the cause of the Amír of the Afgháns. Throughout this period there was a spasmodic excitement all along the border line. In 1877 a raid on the Yusafzai border by Búnérwáls, instigated by Ajab Khán, a leading Khán in the Pesháwar District (for which he was hanged), exposed in a glaring manner the evils of employing middlemen, residing in British territory, to conduct relations between British officers and the frontier tribes. This system was an inheritance from Sikh times; it was forced upon frontier officers by their initial ignorance of the people and their language. Occasionally producing satisfactory results, in the majority of cases the middleman abused his position for private ends; or, where himself disinterested, was unable to counteract the operations of his relations or faction. For the last eight years the principle of establishing direct personal relations with independent clans has been steadily kept in view. It has as yet produced the best results by winning the confidence of the hillmen in the motives of Government and by removing the risk of chicanery and intrigue in dealing with the tribes. At the same time attention has been paid to the acquisition by British officers of a knowledge of the language, habits and feelings of the Afgháns, without which knowledge it is impossible to maintain the principle that has now been adopted in border management. In 1876-77 the blockade of the Kohát Pass Afrídís caused some excitement. The expedition against the Jowákís that followed is remarkable, partly for the number of troops employed, but chiefly as being the first occasion on which the revolution effected by the breechloader in border warfare became apparent. Hitherto, the hillmen and British troops had met, in regard to their arms, on somewhat equal terms. In the first Afghán War the *jezail* was a decidedly better weapon than the musket of the British forces. The introduction of the Enfield rifle brought the balance over to the British side, and the breechloading rifles, which the European and native army now possess, cannot be compared with the antiquated weapons of the clans. The events of the recent Afghán War do not come within the scope of the present narrative. Its course was marked on the frontier by raids on the Hazára border, attacks on the line of communications in Kohát, and the burning of Tánk, in the district of Dera Ismail Khan, by Mahsúd Wazírs. The Hazára and Kohát tribes have been punished by fines and blockades; among the latter the Zaimúkht by a successful expedition; and the Mahsúd Wázírs by an expedition in force in 1881, which compelled them to make the reparation demanded by Government. The border tribes are now free from that general restlessness that was noticed during the war. On the withdrawal of British troops from Northern Afghánistán and the Khaibar, in October, 1880, the Pass was made over to the Afrídís, who engaged to keep it open, receiving allowances therefor, with the aid of a corps of Jezailchís raised from their midst. The experiment of placing the safety of valuable caravans in the hands of hereditary robbers and murderers has proved hitherto a remarkable success. The Khaiber within the limits of British influence, as far as Landi Khána, has been

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literally as safe to travellers as the Grand Trunk Road. During the past thirty years of frontier management constant intercourse with British officers, unrestrained trade with British subjects, and employment in the military and civil establishment of Government have greatly altered the suspicious and hostile character of the border men; while opportunities for travelling in British territory, the improved armament and organization of the British forces, the lessons of the recent war and the fall of two consecutive Amírs of Afghánistán, and lastly the advent of the railway to their doors, are producing among the tribes that feeling of despair of any successful resistance, in the event of a collision with the power and resources of the British Empire, which is the surest guarantee for the future tranquillity of the border districts.

CHAPTER IV.

THE PEOPLE.

SECTION A.—STATISTICAL.

Chapter IV, A.

Statistical.

Successive Enumerations.

The first reliable census of the Punjab was taken on the 1st of January, 1855. At this time the Delhi territory was not included in the Province. The population of the tract thus excluded had, however, been enumerated at the census of the North-Western Provinces taken on 1st January, 1853, with the exception of the present district of Sirsa, for which the earliest reliable figures are obtained from a settlement census taken village by village between 1852 and 1862.* The next census was taken on the 10th of January, 1868, and embraced the whole British territory of the Punjab as it now stands, but did not extend to the dominions of the Native States. The most recent enumeration was made on the 17th February, 1881, and included the whole population of the Province.† Thus, roughly speaking, the three enumerations of 1855, 1868 and 1881 are separated by identical intervals of a little more than 13 years. In the following paragraphs the figures of the census of 1881 are always referred to, save when the contrary is expressly stated.

Distribution over Towns and Villages.

Of the total population of the Punjab, 87·35 per cent. is rural and 12·65 urban, the rural proportion being largest in the hills and in the western districts. The people inhabit 52,870 villages and towns, which may be classed as follows according to the number of their inhabitants :—

Territory.	Under 200.	200 to 500.	500 to 1,000	1,000 to 2,000.	2,000 to 3,000.	3,000 to 5,000.	5,000 to 10,000.	10,000 to 20,000.	Over 20,000.
British territory	11,937	11,879	6,348	2,954	693	349	115	28	21
Native States ...	13,899	2,803	1,142	512	108	45	27	7	3
Province ...	25,836	14,682	7,490	3,466	801	394	142	35	24

The towns of more than 50,000 souls are Delhi 173,393, Amritsar 151,896, Lahore 149,369, Pesháwar 79,982, Mooltan 68,674, Umballa 67,463, Patiála 53,629, Káwalpindi 52,975, Jullundur 52,119.

The average population per village (excluding towns of over 5,000 souls) is 481 for British territory and 377 for the Province. But the figures do not fully represent the distribution of the population over units of habitation. The land-owning tribes of the west of the Province, many of whom have but lately abandoned pastoral for agricultural pursuits, are often spread over their tribal

* NOTE.—A rough enumeration had previously been made in 1849.

† NOTE.—It also included some 8,000 souls cantoned in the Khaibar Pass at the time of the census in connection with the recent operations in Kabul. These consisted for the most part of troops and camp-followers ordinarily resident in the Punjab; their number is insignificant, and they will be treated for present purposes as a part of the Punjab population.

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Distribution over Towns and Villages.

territories in numerous small hamlets, and the "village" is merely a group of these hamlets included within a common boundary for administrative convenience. So where, as in the Himalayas and in many parts of the frontier and Salt Range tracts, a small body of some dominant race are the over-lords of a subject population, the former are often concentrated into a few large villages, while the latter are widely scattered over the area they still cultivate. Thus in the hills and in parts of the western divisions the village is a purely artificial unit, and the extraordinary number of small villages returned for Native States is due to the fact that, in the Hill States, each hamlet has been treated as a separate village. Excluding these portions of the Province, the average village is largest where the rule of the Government which preceded our own was weakest and peace least secure, where the land-owners belong to the ruling races of the Punjab, and where a rude agriculture, largely supplemented by pastoral pursuits, renders a considerable area at once necessary to and manageable by the village.

Distribution over Area.

The number of souls per square mile is 177 for British territory and 159 for the Province. If the urban population be excluded, the figures fall to 154 and 139. The population of British territory numbers 514 per cultivated and 257 per culturable square mile; and the exclusion of the towns reduces these densities to 448 and 224. The density of rural population on total area varies from 493 per square mile in Jullundur to 42 in Dera Ismail Khan. It is greatest in the submontane zone, and the region of the Eastern Plains, which lies immediately below it. The Jumna districts follow next; after these come the districts of the hills and of the Salt Range tracts; while the density is smallest in the west and in the southern districts of the Eastern Plains. The primary conditions that determine the density of population is the existence either of an ample rainfall, or of a spring-level of such moderate depth as to render irrigation easy. This condition satisfied, the intrinsic fertility of the soil is the secondary factor. The distribution of the population by districts is shown in statistical table Nos. 1 and 2.

Distribution among Houses and Families.

The leading figures for the distribution of the people among houses and families for the Province are shown in the margin.

	Villages.	*Towns.*
No. of families per occupied house ...	1·47	1·54
" persons " " ...	6·84	6·17
" " " resident family ...	4·66	4·00

The number of souls per occupied house in villages ranges from 9·41 in Karnál to 4·93 in Dera Ismail Khan. The general custom is that as soon as the sons marry they occupy separate houses, especially where tribal rules do not forbid marriage between cousins as incestuous; and the results of successive enumerations seem to indicate that the tendency towards early separation is progressive. But it is always difficult to discriminate satisfactorily between a house proper and the family courtyard, which includes several separate buildings; and the value and significance of the figures are very doubtful. The statistics for families are more satisfactory, as the unit is clearly defined by the test of commensality. They are extraordi-

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Distribution among Houses and Families.

narily uniform, the number of souls per family varying in 28 out of the 32 districts between 5·15 and 4·19. Thus the great undivided families of Eastern Bengal are wholly unknown in the Punjab; and as regards domestic life, the family unit is a small one. But the same degree of severalty does not extend to rights in land or to the operations of agriculture; for ancestral landed property often remains joint for several or many generations, while its cultivation is commonly conducted by associations of smaller but still considerable size.

Migration and Birth-place.

The figures for birth-place collected in 1881 enable us to trace the migrations of the people within the lifetime of the present generation, but not to fix the date of the movements which they register. Of every 1,000 living persons born in the Punjab, 13 have emigrated to other countries or Provinces, while in their place we have received 35 immigrants from without; thus the total gain by migration to the indigenous population is 2·2 per cent. The distribution of the migrants is shown below :—

Country.	Proportion per mille of total		Number of emigrants per 1,000 immigrants.			Number of males per 1,000 of both sexes among	
	Emigration.	Immigration.	Persons.	Males.	Females.	Emigrants.	Immigrants.
North-Western Provinces	498	342	542	478	615	481	546
Rájpútána	288	305	349	258	443	366	497
Sind	103	5	7,500	8,000	7,000	702	660
Afghánistán	...	148	...	...	...	...	615
Kashmir	...	148	...	...	...	...	528
Other countries ...	111	52	...	...	...	...	...
Total ...	1,000	1,000	371	337	414	499	549

The famine which ravaged Kashmir just before the census, and the extraordinary demand for labour on the route to Kabul, combined to raise the immigration from beyond our border above its normal figures. The general tendency of population being to move in the direction of least pressure, the local density of population very largely determines the course of migration. But while this is the case at the two extremes of the scale, it is found that among districts only moderately populated the existence of the same conditions, which have already drawn a more dense population to one than to another, still tend to attract people from the latter to the former.

The proportion of indigenous to total population for the whole Province is shown below :—

Numbers per mille born in	Towns.		Villages.		Total.	
	Male.	Female.	Male.	Female.	Male.	Female.
The District or State ...	741	764	919	874	895	860
The Province	892	922	979	973	967	966
India	981	994	995	996	994	995

Course of Migration in the Punjab.

The Punjab, fast developing under strong and settled rule, has attracted to itself population from the countries that surround it on

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Course of Migration in the Punjab.

all four sides—from the North-Western Provinces, Rájpútána, the trans-frontier districts, and Kashmir. From the north and west the movement has been almost wholly in one direction; but on our eastern and southern borders the immigrants have retained their connection with their original homes, and more especially have looked for wives for their sons and husbands for their daughters from among their father's people, and a considerable reflex movement has resulted.

Within the Province, movement of population is very largely confined to crossing the border from one district or State into its neighbours. In the Eastern Plains, where no physical obstacles bar the way, and where varying conditions, frequently recurring droughts, and in some parts pressure of population, tempt or compel the people to move, migration is more common than in the west. The till lately almost uninhabited prairies of Hissar and Sirsa have tempted crowds of immigrants from arid Rájpútána and from the Native States to their north, while the population of the central plains has also moved northwards, eastwards, and westwards, towards the rivers and the canals which distribute their waters. The submontane districts have a population more dense than their culturable area can support in comfort, and their surplus numbers are moving southwards into the river valleys, and even beyond them into the central plains and the lands newly irrigated by canals. Throughout the Eastern Plains and submontane zone, and especially in the eastern portions of these tracts, social custom prescribes that the bride shall be brought from a distance; and a very considerable exchange of women accordingly takes place across the border of neighbouring districts and States. Within the Himalayas themselves the nature of the country renders migration difficult, and the population is peculiarly stationary, the chief movement being a periodic descent from the high ranges to winter in the warm valleys.

In the Western Plains there is little pressure of population, physical conditions are uniform, famine is unknown, the arid steppes present obstacles to migration, and the people move but little. Yet the fertile plains of Sind have attracted settlers in considerable numbers from Baháwalpur; the recent extension of inundation canals on the Indus, Sutlej and Chenab has drawn numerous immigrants from the neighbouring districts and from Rájpútána, while there are signs that the pastoral tribes of the central steppes are gradually moving into the river valleys, though it is not impossible that the movement towards the rivers, observable both in the eastern and the western plains, is partly temporary, and due to the years of scarcity which preceded the census. The people of the Salt Range tract and of the trans-Indus frontier are a peculiar people, who do not mix freely with the inhabitants of the Punjab proper, and there is but little movement between these two portions of the Province. But the tribes of the Pathán border are gradually acquiring lands and settling in considerable numbers in British territory; while year by year, as winter approaches, the hillmen move down to the Punjab plains to cultivate, to trade, or, together with thousands from the far hills of Hazára beyond Kabul, to work as labourers.

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Course of Migration in the Punjab.

The only portion of the Province where real pressure of population is felt is that which includes or lies immediately under the low hills. The parallel zone to the south of it, which combines a fertile soil with facilities for irrigation in a higher degree than any other part of the Punjab, has hitherto received its surplus population, while the construction of the Bári Doáb and the Ferozepore inundation canals has greatly facilitated the transfer. And now that the capacity of that fertile zone to receive the surplus numbers of other parts has been taxed to the uttermost, and it possesses as dense a population as it is able to support, the Sirhind Canal is about to irrigate the central plains, and so to open a wide outlet by which the pressure of population to their north may find relief. Further to the west the projected canal from the Chenab into the Gujránwála bár will perform a similar office for the sub-montane districts of that part of our border, and will test the possibility of inducing the Punjab peasant to move beyond that moderate distance with which he has hitherto been contented—a test the importance of which to the Punjab, with its great unpeopled stretches of fertile soil, can hardly be over-estimated.

Tendency of the Urban Population to concentration, and of the Rural to dispersion.

The tendency of the population to collect in the large towns is brought into strong relief by a comparison of present with past figures. The improvement of communications has reduced the importance of local centres of commerce; the gradual advance of civilization is creating new and developing existing industries, and so ever increasing the demand for labour other than agricultural; and the great cities of the Province are increasing rapidly at the expense both of their smaller rivals and of the surrounding villages. At the same time the opposite process is going on in the rural tracts; the necessity of self-protection no longer confines the people within walled villages of some considerable size; and they are constantly tending to spread themselves more and more widely over the fields they cultivate.

Increase and ecrease of Population.

The population of British territory, as ascertained at the three enumerations mentioned above, is as follows, proportions per mille being given below the actual figures :—

Year of Census.	Persons.		Males.		Females.	
1855	15,161,321		8,357,786		6,803,535	
1868	17,609,518		9,594,308		8,015,210	
1881	18,850,437		10,210,053		8,640,384	
1855	1,000	...	1,000	...	1,000	...
1868	1,161	1,000	1,148	1.000	1,178	1,000
1881	1,243	1,071	1,222	1,064	1,270	1,078

The annual rate of increase per cent. is shown in the margin.

1855—1868	...	1·3
1868—1881	...	0·6
1855—1881	...	0·9

On the whole, the increase has not been so rapid as might have been expected. But it must be remembered that it is only 34 years since the Province was rescued from something like anarchy and brought under a civilized rule; that there are still five millions of persons in the Punjab who might remember Ranjít Singh, or who were at any

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Increase and Decrease of Population.

rate alive when he died; and that seven millions, or nearly one-third of the population, were born under Sikh rule. Even of such increase as has taken place, a part is due to increased accuracy of enumeration, especially of females, while a still larger portion is due to gain by migration. According to the figures, the gain during the first interval of 13 years was 16·1 per cent., and during the second and similar interval only 7·1 per cent. But the discrepancy is probably largely accidental. Most marked in the history of vital statistics in India are the violent fluctuations that characterise them. The enumeration of 1855 was taken exactly half way between two periods of depression, and before the good effects of annexation had had time to make themselves fully felt; that of 1868 was taken after seven years of quite exceptional prosperity; that of 1881 immediately after three years of sickness, war, and agricultural distress. At the first census the vital pendulum was midway, at the second at its highest, and at the third at its lowest point.

Setting aside those districts in which special development of irrigation has attracted, or of cultivation has followed upon, extraordinary immigration, we find that the rate of increase has been highest in the thinly-peopled and arid western plains; in the east of the Province it has been largest in the central part, and next largest in the Jumna districts; while in the hills the population has stood still, and in the submontane zone has actually decreased.

The Ages of the People.

It has already been shown that the census of 1881 was taken at a time when the vital pendulum was at its lowest point in the Punjab, and it is almost certain that the fact has markedly affected the age statistics, the proportion of children enumerated being smaller than in a normal year, owing to the temporarily depressed state of the population. Notwithstanding this, a large proportion of children and a low average of life still characterise the people as measured by an English standard, the latter feature being most marked in the west, and the former in the east, and the large proportion of children being probably due, partly to the short average life of the generation, but still more to the fact that almost every woman in the Punjab marries. The following figures show the distribution of every 10,000 of each sex by age :—

Sex.	0—	10—	20—	30—	40—	50—	60—	All ages.
Males ...	2,604	2,099	1,701	1,354	995	662	582	10,000
Females ...	2,746	1,907	1,790	1,358	1,013	614	572	10,000

The Civil Condition of the People.

The figures in the margin show the distribution by civil condition of every 10,000 persons of all conditions in each sex. Perhaps the most striking fact disclosed by the statistics is the very considerable proportion of the men who never marry at all. Of the whole male popula-

Civil condition.	Males	Females.	Persons.
Single ...	5,217	3,565	4,460
Married ...	4,166	4,989	4,544
Widowed ..	617	1,446	996
All conditions	10,000	10,000	10,000

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Statistical.

The Civil Condition of the People.

tion of between 30 and 40 years of age, no less than 14·5 per cent. is single, while in the Deraját the percentage rises to 20. It is almost certain that this abstinence is chiefly due to prudential reasons. Among females marriage is almost universal, there being, after 30 years of age, not one woman in 200 single in the Delhi Division, and not three in 100 in the Pesháwar Division. The age of marriage rapidly advances from east to west, among both males and females, and is always far earlier for the latter than for the former. Between 10 and 15 years of age nearly half the women are married in the east, whereas four-fifths of the men are still single, while even in the west about a fifth of the girls have found husbands. By the time they are 20 years old, 92 per cent. of the girls are married or widowed in the east, and 70 per cent. in the west. In the south-west of the Punjab marriage does not take place as a rule till both parties have arrived at full puberty. As to the effect of religion upon civil condition, the above remarks apply broadly if we read Hindús for east, Muhammadans for west, and put Sikhs between the two. And this is true of Hindús in the west, and of Mussalmáns in the east, though to a less degree than in their own proper tracts.

There are according to the figures 1,011 wives for every 1,000 husbands, so that polygamy is not common. It is practically confined to the wealthier classes, though more common among Mussalmáns than among Hindús, and in the Pesháwar Division and Salt Range tract than elsewhere. But the custom of *karewa*, by which the widow devolves to the younger brother of the deceased, prevails among all but the highest castes throughout all the eastern half of the Province. Polyandry is a recognized institution only in parts of Kullu and Láhul, and even there it seems to be dying out. But it is not at all certain whether among the Jats and similar castes who practice *karewa* the elder brother's wife, in the east of the Province at least, is not common to all the brothers.

The Proportion of the Sexes.

The figures in the margin show the number of females per 1,000 males for each religion for—

Religion.	0—2	0—5	All ages.
All religions ...	949	945	843
Christians ...	919	953	337
Sikhs ...	855	839	765
Hindús ...	945	941	834
Mussalmáns ...	367	962	864
Jains ...	990	936	878
Buddhists ...	1,250	1,255	1,100

(1) The first two years of life.
(2) The first five years of life.
(3) All ages. The general proportion of females to males in the earlier years of life does not appear abnormally low when compared with European (not English) standards. But it rapidly decreases as maturity is reached. Thus, excluding the period of early puberty, when female ages are very generally wrongly returned, we find that the proportion of infancy, which is 949, drops to 911 between the ages of 20 and 25 to 873 between 25 and 30, and to 868 between 30 and 35. And the sudden decrease during the years of child-bearing is most marked amongst the early marrying Hindús.

The Proportion of the Sexes.

The figures for Sikhs are extraordinary, but their constancy seems to show that they are accurate. Among the different castes the proportion of females is largest among the outcastes and vagrants who prostitute their women, and smallest among the higher castes; the artisans standing midway. The figures for all the large castes which have a proportion below the average are shown in the margin. The following figures are striking:—

All castes ...	843
Thakur ...	761
Khatri ...	770
Ahír ...	792
Jat ...	799
Brahman ...	832
Rájpút ...	838
Patháu ...	838
Arora ...	838

Jats—Total ...	799	*Rájpúts*—Total ...	838
Mussalmán ...	838	Mussalmán ...	856
Hindú ...	795	Hindú ...	776
Sikh ...	747	„ Kángra ...	906
Amritsar, all religions ...	741	Hoshiárpur, Mussalmán	880
„ Sikh ...	730	„ Hindú ...	860
		Gurdáspur, Mussulmán	873
		„ Hindú ...	738
Brahmans—Total ...	832	*Khatrís*—Total ...	770
Kángra ...	925	Hindú ...	774
Hoshiárpur ..	885	Sikh ...	745
		Hoshiárpur ...	774
		Amritsar ...	772
		Gurdáspur ...	667

It is almost impossible, if the figures are to be trusted, that infanticide, or even injurious depreciation of female life, should be at all general in the Punjab. But the figures for Sikhs generally, for Sikh-Jats and Khatrís particularly, and for the Hindú Rájpúts of the low hills, are suspiciously low; while those for the Sikh-Jats of Amritsar, and still more for the Sikh-Khatrís of Gurdáspur, are more than suspicicusly low.

The Occupations of the People.

The figures for occupations are the most unsatisfactory of all the census statistics, owing to the system of classification adopted. The figures in the margin show the main occupations expressed in proportions per mille. The proportion of purely agricultural to total population is largest in the west and in the Hissar Division, and smallest in the Amritsar, Lahore and Mooltan Divisions. The proportion of the industrial classes naturally varies in inverse order. The occupations of women are probably returned very imperfectly. In the hills and the eastern and south-eastern districts the women of Jats, and of most castes of the same or lower standing, commonly work in the fields. In the Western Plains women take hardly any share in field labour. Throughout the remainder of the Province only the women of

Occupation.	Proportion per mille.		
	Towns.	Villages.	Total.
Administration and defence ...	115	15	30
Agricultural and pastoral ...	156	599	536
Village menials	108	106	106
Workers in fabrics... ...	118	68	75
Do. in food	46	9	14
Miscellaneous industries ...	79	15	27
Labourers	97	51	57
Traders and carriers ...	108	47	54
Unproductive	152	82	92

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The Occupations of the People.

Arains, and of castes of the same or lower standing, take any share in agriculture, the Jat women as a rule not working in the field. But almost all women, save those of quite the wealthiest classes, are engaged in domestic duties which are generally unremitting, and often severe. The children of the poorer classes are set to work as soon as they have the necessary intelligence, while the children of husbandmen tend cattle and perform similar light duties from a very early age.

The general distribution of the population by occupations may be thus summarized. Of the male population of over 15 years of age, 53·6 per cent. follow purely agricultural and pastoral pursuits, while 1·5 per cent. more according to the figures, but in reality a much larger proportion, combine cultivation with other occupations. The husbandmen proper comprise 30 per cent. who have a proprietary interest, and 19 per cent. who have tenancy holdings in the land, while three per cent. are in a position little better than that of day-labourers. In the villages the agriculturists number 60 per cent. of the whole, while they are in east and centre of the Punjab largely assisted by agricultural village menials, who form another seven per cent. of the village population. Besides these cultivating menials, other village menials, paid for the most part by receiving a share of the produce, constitute another six per cent. ; so that not less than 73 per cent. of the whole village population, and at the very least 16 per cent. of the town population, depend almost, if not quite, entirely for their subsistence upon the varying nature of the seasons and upon the produce of the fields. Of the remaining village population three per cent. are priests and professional men, whose income also depends largely upon a favourable harvest ; five per cent. belong to the mercantile and money-lending class, whose livelihood is comparatively secure ; seven per cent. are artisans, such as weavers and the like, whose income is always small, but not directly dependent upon the seasons, though distress and high prices must always affect soonest the poorest classes ; while four per cent. are coolies and day-labourers, dependent for bare subsistence upon each day's chances ; and another four per cent. are beggars and *fakírs*. Government and domestic service account for the remaining three per cent.

Of the adult male population of towns 16 per cent. are purely agricultural and pastoral, while a considerable proportion of the menials in the smaller towns are paid according to the outturn of the harvest. Some 10½ per cent. belong to the mercantile, 2½ per cent. to the carrying, and three per cent. to the priestly and professional classes, all of whom are tolerably secure of their livelihood, as are most of the 4½ per cent. who work and deal in articles of food. Government and domestic service provide employment for 17½ per cent., while about eight per cent. are menials who are chiefly employed in serving the wealthier classes, and are not so wholly dependent as many others upon the fluctuations of trade and of the labour market. Ordinary artisans constitute 12½ per cent. of the whole, and are as a rule comfortably off, according to their position in life ; but the weaving classes, who comprise eight per cent. more, are often

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The Occupations of the People.

miserably poor. The day-labourers, who are seldom certain of a day's food in advance, constitute 10 per cent. of the whole urban population, while the *fakírs* and beggars amount to four per cent. more, leaving only 3½ per cent. unaccounted for.

Of the total female population over 15 years of age, 76 per cent. have had no occupations returned for them, and must be supposed to be chiefly employed in domestic duties, though the numbers who are compelled to earn their own living either wholly or in part are probably much larger than would appear from these figures. Of the women for whom occupations are recorded, 39½ per cent. assist their husbands in cultivation, and six per cent. in industrial occupations. Minor branches of the weaving trade employ 6½ per cent. more, domestic service and attendance upon the wealthier classes occupy 11 per cent. of the whole, while 3½ per cent. follow professional pursuits. The remaining 33½ per cent. of the female population of towns are miserably poor, and earn their bread by daily labour of the most uncertain kind: 15 per cent. by spinning; 12½ per cent. by general labour, such as gathering cow-dung, grass or fuel, or working as common coolies; and 4½ per cent. by begging.

The Education of the People.

The census figures should include only those who have learnt or are learning both to read and to write; but it is probable that many who were learning to read only have been included, and it is certain that the figures for females are practically worthless. The following figures show the state of education according to the census tables:—

Religion.	Males per 10,000.				Female Population.			
	Rural Population.		Total Population.		Rural Population.		Total Population.	
	Under instruction.	Can read and write	Under instruction.	Can read and write.	Under instruction.	Can read and write	Under instruction.	Can read and write.
All religions	100	342	142	468	3·0	3·3	6·3	8·9
Hindú ...	110	596	171	789	1·2	2·6	2·4	5·6
Sikh ...	86	372	111	471	2·0	5·4	4·4	7·4
Jain ...	361	3,318	646	3,702	9·2	9·6	9·5	13·1
Buddhist ...	213	1,293	213	1,293	...	...	..	...
Mussalmán	94	128	118	169	4·1	2·3	6·5	5·0

Taking the figures as they stand, male education is highest in the west, and after that in the central districts; and lowest in the hills, the submontane districts and the central and southern portions of the eastern plains. The pre-eminence of the western districts is probably due to the large number of Korán schools, where the boys learn always to repeat by rote, sometimes to read, but never to write. The figures indicate that there has been a very considerable general advance in education during the present generation, while among Mussalmáns, and among women, the progress has been enormous.

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Statistical.

The Infirmities of the People.

The figures in the margin show the number suffering among every 10,000 of the population from each of the recorded infirmities.

Infirmities.	Males.	Females.	Persons.
Insane ...	6	4	5
Blind ...	49	54	51
Deaf-mutes ...	14	9	12
Lepers ...	6	2	4

Insanity is most common in the south-western districts, where the figures for males vary from 12 to 15; next most common in the hilly districts, where they range from 6 to 10; and less frequent to an extraordinary degree in the central and eastern plains, where they vary from 2 to 5. Goitre is prevalent in the south-western districts and in the hills. Insanity is everywhere most common among Mussalmáns, and least frequent among Sikhs, except where the Sikh population is wholly mercantile and military. Insanity is rare before 10 years of age; it develops largely between 15 and 20 for males, and between 10 and 15 for females; and again rises suddenly after 40 years of age for females only.

Blindness is far more common among women than among men. It is most frequent in the districts which consist of great open plains, often sandy and exposed to glare and hot wind, and least frequent in all the hilly districts. In the latter the proportion varies from 10 to 30, while in the former it rises to 74. The figures show a very marked decrease since 1868, especially among males. Blindness develops very late in life, and more than half the living blind are, if the figures are to be trusted, over 50 years of age. This is especially the case with females.

Deaf-dumbness is far more frequent among men than among women. It is most common in the hilly and submontane tracts, where the proportion varies from 20 to 48; next most common in the south-western districts, where the figures range between 12 and 18; and least frequent in the central and eastern districts, where the proportion is from 7 to 10. This order is very similar to that observable in the case of insanity. Only congenital cases were recorded.

Leprosy.—The figures possibly include cases of mere epidermal discoloration, which it is often difficult to distinguish from true leprosy. The proportion of lepers is two and a half times as great among males as among females. The districts are arranged without a break in order of prevalence of leprosy, thus—hills, submontane, eastern plains, western plains. The affection is most common among Hindús and least among Sikhs, and more frequent in villages than in towns. The figures show a very large decrease since 1868, which may be partly due to more careful exclusion of cases of mere discoloration. Leprosy is almost unknown in childhood; it seldom develops before 20 years of age, and generally much later. Nearly a third of the lepers of each sex are returned as over 50 years of age.

Rates of Mortality.

The following table shows the mortality from the more common diseases during the past 15 years :—

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Rates of Mortality.

Year.		Cholera	Small-pox.	Fevers.	Bowel complaints.	All other causes.	Total.	Death-rate per mille of population.
1868	...	532	24,222	151,337	17,823	73,871	267,785	15
1869	...	9,258	53,169	272,946	30,953	87,495	453,821	26
1870	...	469	27,163	275,093	27,249	88,953	418,926	24
1871	...	369	25,534	213,548	21,678	102,249	363,378	21
1872	...	8,727	23,728	264.711	23,345	110,097	430,603	25
1873	...	148	25,699	219,909	19,640	91,757	357,153	20
1874	...	78	12,026	190,631	16,407	97,571	316,713	18
1875	...	6,246	13,594	279,841	27,550	119,977	447,208	26
1876	...	5,736	10,254	351,286	27,271	102,297	496,844	28
1877	...	29	12,296	219.281	17,664	101,662	350,932	20
1878	...	215	40,271	440 492	32.071	115.722	628,771	36
1879	...	26,315	49,489	472,939	29,612	95,038	673,213	33
1880	...	274	9,145	327,727	22,730	114,849	472,731	27
1881	...	5,207	6,749	355,279	17 281	135,263	519,779	30
1882	...	39	6,379	346,674	15,965	135,742	504,729	27

In 1882 the rates of mortality at different periods of life were for the first time shown. Twenty-three per cent. of infants, or nearly one-fourth, died in the first year of life; the rate continues high among children between the ages of 1 and 5; after this it falls rapidly, the period between 10 and 15 years being that of the lowest mortality. Among children under 5 the ratio of mortality is lower for females than for males; at ages between 5 and 10 the ratios for the two sexes are nearly equal. At all ages from 10 to 40 females died at a higher rate than males, but the excess is greatest between 20 and 40; above 40 and up to 60 males died at a higher rate than females.

SECTION B.—SOCIAL.

The Religions of the People.

The distribution of the population by religions is shown in the margin. But the figures for each of the first three religions include considerable numbers of outcasts, impure by virtue of their food or occupation, who would not be recognized as fellow-believers by the more orthodox members of the creeds which they profess. This is especially the case with the Hindús, among whom have been classed all natives who did not return any one of the other great recognized religions. So, again, the figures for Sikhs may, and possibly do, include a certain number of persons who, though followers of Bába Nának, are not Singhs or followers of Gúru Govind, and therefore not Sikhs in the common acceptation of the term. With the exception perhaps of Jainism, the practice of the religions as followed by the mass of the peasantry in the Punjab is exceedingly impure. The great Hindú gods are superseded by a host of minor deities, many of them malevolent; while the principal objects of reverence to both Hindús and Mussalmáns are the famous saints of the Punjab, Sakhi Sarwar, Gúga Pír, Bábá Faríd, and the like, who are worshipped indifferently by the followers of both

Religions.		Persons.	Proportions.
All religions ...	...	22,712,120	1,000
Mussalmáns	...	11,662,434	5,135
Hindús ...	...	9,252,295	4,074
Sikhs ...	...	1,716,114	756
Jains ...	...	42,678	19
Christians ...	...	33,699	15
Buddhists ..	...	3,251	1
Others and unspecified ...		1,649	...

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The Religions of the People.

religions. All alike are sunk in the grossest superstition, and in the most abject submission to their spiritual pastors. The Buddhism of Spiti belongs to the grossest school of the creed, filled full of foul imaginings, and with a large admixture of Hindúism, while the religion of the Himalayas may be best characterised as the worship of the gods or demons of the groves and high places.

It is even difficult in many cases to draw any very definite lines between the several creeds. In the great religious centres, and everywhere among the more educated classes, the distinctions are sufficiently well marked. But in the border lands where the great faiths meet, and especially among the ignorant peasantry, the various observances and beliefs that distinguish the followers of the several faiths in their purity are so strangely blended and intermingled that it is often almost impossible to say that one prevails rather than another. Thus the Mussalmán peasantry of the Delhi territory are still in many ways almost as much Hindú as their unperverted brethren; the Sikh of Sirsa is often a Sikh only in speech and habit; while the Hindú of Láhul is almost more a Buddhist than a Hindú.

Local Distribution of Religions.

Islám is most predominant in the Pathán districts of the Pesháwar frontier, where Mussalmáns constitute 95 per cent. of the rural population. After them come the Salt Range tract and the Bilúch frontier, closely followed by the remaining districts of the Western Plains. In all of these 75 per cent. or more of the villagers are Muhammadan. Next come the districts between Lahore and Jullundur and Sirsa. Within this group the proportion falls from 67 to 38 per cent., while in the remainder of the Punjab it nowhere rises higher than 30 per cent.

The hill tracts are very markedly the most Hindú portions of the Province, 95 per cent. of the rural population following that religion. Next to them in order of Hindúism, if for the moment we count Sikhs as Hindús, comes the south-eastern portion of the Punjab, in no part of which does the percentage fall below 78. This is followed by the north-eastern districts.

The Sikh element is strongest in the great States of the Eastern Plains, where the followers of that religion number as many as 30 per cent. of the total population, the highest figure being 57 per cent., reached only in Máler Kotla. Next come Amritsar, Ferozepore and Ludhiána, with a Sikh percentage of from 23 to 27. Lahore follows with 17, and Jullundur, Sirsa and Kapurthala with 12 to 13 per cent. In the remainder of the Province the Sikh element is exceedingly small.

The Jains are naturally strongest in the districts bordering upon Rájpútána, the great stronghold of their faith in North-Western India. But even here they rise above one per cent. of the total population in Delhi only; while west of Lahore they barely form a perceptible element. The Buddhists are found only in those parts of Kángra and Chamba which border on and geographically belong to Tibet.

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Social.

Local Distribution of Religions.

The Christians and Zoroastrians are almost wholly confined to the towns; while of the Buddhists of the Punjab, all, save one, are to be found in the villages. The Sikhs are almost wholly rustics, except on the frontier, where they are almost entirely traders or soldiers. The Hindús show a larger urban proportion than do the Mussalmáns, the latter dwelling more largely in towns in the east, and the former in the west, or where the religion of each is less prevalent. But the urban proportion never rises so high among Mussalmáns as among Hindús, for west of Jhelum the latter are almost exclusively traders, and on the frontier hundreds of villages do not contain a single Hindú.

Outside the towns it may be said, speaking very generally, that wherever Hindú and Mussalmán landowners occupy a tract of country side by side, the latter chiefly lie along the rivers, while the former will be found in greater numbers in the more arid doábs which lie between.

Composition of Religions by Caste.

The followers of each of the main religions are very roughly classified by caste in the margin. Of the Hindús, 16·6 per cent. are Jat, 4·1 Rájpút, 11·6 Brahman, 6·0 Arora, 4·3 Banya, 4·2 Khatri, 10·2 Chamár, and 6·7 Chúhra. Of the Sikhs, 66·3 are Jats, 6·5 Tarkháns and 5·6 Chamárs. Of the Jains, 72·3 are Banya and 26·5 Bhábra. Of the Mussalmáns, 15·7 are Jat, 11·1 Rájpút, 4·0 Gújar, 7·5 Pathán, 6·8 Arain, 4·4 Awán, 3·0 Bilúch, and 4·9 Juláha.

Class of Caste.	Proportion per mille among				
	Hindús.	Sikhs.	Jains.	Mussalmáns.	All religions.
Agricultural ...	343	702	...	570	490
Religious ...	133	7	1	75	94
Mercantile ...	147	47	988	11	73
Artisan ...	134	137	4	276	209
Menial and outcast	205	96	...	38	112
Others ...	38	11	7	35	25

Progress of the several Religions.

A comparison of the figures of 1868 and 1881 would seem to show that during the interval Muhammadanism has made some very slight progress at the expense of the Hindú group of creeds, especially in the centre of the Province. But owing to defects of classification in the earlier census, the comparison is unsatisfactory. So far as statistics are available, Sikhism would appear to have made an extraordinary advance between 1855 and 1868. But it is probable that in 1855, immediately after the fall of the Khálsa, Sikhism was in temporary disgrace, and that the common people feared to rank themselves in a return made to an English Government among those who had so lately been opposed to us in battle. Since 1868 the number seems to have fallen off; and there is little doubt that, notwithstanding the temporary stimulus which the Kabul campaign afforded to an essentially military cult, Sikhism is on the decline. Buddhism too is rapidly giving way before the advance of Brahmanism, and before the next generation has passed away will probably have almost ceased to exist in the Punjab as a separate religion. The figures afford no basis for a comparison in the case of Jains.

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The Languages of the People.

The figures in the margin show the main languages spoken by the people of the Punjab. But here again, far more even than in the case of religions, the gradations are so imperceptible and the dialects so numerous that no clear lines of demarcation can be drawn. Bágri is only the northern form of the western or Márwári dialect of Rájpútána. Hindústání includes the Púrbía or Baiswári and Bhojpúri dialects, returned by 25,293 people, the literary Urdu of the educated classes, and the Hindi or Braj of the peasantry of the Delhi territory. Jatki, if not a dialect of Sindi, stands half way between that language and Punjabi; while Dogri is only a hill dialect of Punjabi, as Pahári and Gújari are of Hindi.

Language.	Persons.	Proportion per mille.
All languages ...	22,712,120	1,000
Hindústání	4,045,903	179
Bágri	282,351	12
Punjabi	14,210,854	} 626
Other Punjab dialects ...	5,405	
Sindi	5,128	} 71
Jatki	1,604,760	
Kashmíri	49,534	2
Dogri	212,604	9
Gújari	17,696	1
Pahári (Garhwáli) ...	1,272,204	56
Pashtu	903,818	40
Persian	6,145	} 1
Bilúchi	25,748	
English	27,584	1
Tibeti (Bhoti) ...	5,020	} 1
Láhuli (Bunán) ...	10,303	
Kanauría (Tibarskad) ...	12,209	

Pure Tibeti is spoken only in the Spiti Valley; and the languages here classed as Láhuli and Kanaurία are merely the connecting links between it and Pahári, and include every stage of the transition, as they vary from valley to valley down the head-waters of the Chenab and Sutlej.

Local Distribution of Languages.

The language of our eastern border is Hindi. Passing along the southern border the same language prevails, modified by contact with an immigrant element speaking Bágri in the south and Punjabi in the north, till in the Sutlej Valley we meet the western dialect of Punjabi. The meridian of Sirhind in the east, and the course of the Ghaggar from where it crosses that line in the south, may be taken as the boundary between Hindi and Punjabi. Of the latter language five main types may be distinguished. The eastern or Málwa dialect prevails throughout the cis-Sutlej tract. To it succeeds the central dialect, the standard type of the language, which is spoken in its greatest purity in the Mánja or tract lying east and south of Lahore, and including the holy city of Amritsar. Throughout the Punjabi-speaking portion of the Western Plains the western or Pachhádha dialect of Punjabi obtains, and grows more and more corrupt as we move westward, till it becomes the Hindko of the mid-Indus Valley, still a Punjabi dialect, though with a large admixture of Persian and Pashtu. Lastly, the people of the Jhelum and Ráwalpindi districts speak a Punjabi dialect, of which the type is Potwári, or the speech of the eastern portion of the tract, which gradually fades into the corrupt Hindko of the Upper Indus. On the Rájpútána border of Baháwalpur there is a considerable immigrant population speaking Bágri; but, with this exception, Jatki is the language of the whole south-western corner of the Punjab. Beyond the Indus, Bilúchi is spoken by the organized Bilúch tribes who

Local Distribution of Languages.

dwell at the foot of the Sulemáns, but Jatki is the language of the river valley, and is fast driving Bilúchi back into the hills. Passing northward into the Pathán tract, we find Pashtu spoken on the border and Hindko among the mixed population of the riverain ; while moving still further north into Kohát and Pesháwar we have Pashtu as the universal language, though a considerable mixed population of Indian origin still use Hindko among themselves.

The languages of the hills may be said generally to follow the course of those of the plains below them ; but the line separating the Hindi and Punjabi types lies much further west among the former than in the latter, the Káugra Valley being a sort of border land between the two languages. East of this line is spoken Pahári or Garhwáli, of Hindi type. West of it up to the Hazára border is spoken Dogri with its dialects of Chambáli and Chibháli, which is closely akin to the Potwári type of Punjabi of the Salt Range tract. Beyond the Kághán Valley Pashtu obtains; while throughout the northern hills, from the Ravi to the Swát river, the Gújar herdsmen speak a dialect of their own, which is apparently of Hindi affinities. In the low hills along the foot of our Eastern Himalayas, Punjabi, and not Pahári, is apparently the language of the people ; while west of the Ravi, on the other hand, the people who inhabit the strip of plain country at the foot of the hills speak Dogri and not Punjabi. Beyond the mid-Himalayas, in Kanáwar, Spiti, Láhul and Pángi, either pure Tibetan is spoken or languages such as Láhuli and Kanauría, which hold an intermediate position between the Tibetan and Indic types.

There is little doubt that the Urdu type of Hindi is gradually spreading over the Province and superseding the indigenous languages. Pashtu and Bilúchi are rapidly receding before the Hindi dialects, while Tibetan alone makes way against the tide, and is advancing southwards. It is curious that while Brahmanism is driving Buddhism back into the mountains, the sacred language of the latter should at the same time be superseding that of the former religion.

The Castes and Tribes of the Punjab.

The figures below show the numbers belonging to each of the Punjab castes or tribes, which comprises as many as one per cent. of the total population :—

Caste.	Persons.	Proportion per mille.	Caste.	Persons.	Proportion per mille.
All Castes	22,712,120	1,000			
1. Jat	4,432,750	195	13. Awán	532,895	23
2. Rájpút	1,677,569	74	14. Kumhár	486,025	21
3. { Chamár	1,072,699	} 62	15. Banya	437,941	19
{ Mochi	349,272		16. Khatri	419,139	18
4. Brahman	1,084,193	48	17. { Téli	266,888	} 17
5. Chúhra	1,078,739	48	{ Pénja and Qassáb ...	117,468	
6. { Tarkhán	596,941	} 40	18. Sheikh	372,335	16
{ Lohár	310,783		19. Bilúch	355,238	16
7. Pathán	859,582	38	20. Kánét	345,775	15
8. Aráín	800,041	36	21. { Dhobi	133,215	} 11
9. { Jhínwar	433,884	} 30	{ Chhímba	103,491	
{ Máchhi	168,007		{ Lílári, Rangrez, Dhobi, Charhoa	99,410	
{ Málláh	67,935		22. Náí	342,123	15
10. Gújar	627,304	28	23. Faqír	302,324	13
11. Juláha	624,312	28	24. Sayad	248,102	11
12. Arora	601,440	26			

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The Castes and Tribes of the Punjab.

The Province presents two very distinct types of social structure. In the Eastern Plains and throughout the Himalayan region the institution of caste obtains in its proper form, distinctions being based primarily upon occupation, and among the land-owning classes upon political importance, and the tribe being a mere sub-division of the caste. Occupations are by presumption hereditary, and different castes cannot inter-marry. But throughout the Western Plains, and on the Indus frontier, tribe, and not caste, is the social unit among the land-owning classes; the latter, in the widest sense of the term, either having dwindled to a mere tradition of origin, or being a mere ethnic distinction. Here, too, the only restriction upon occupation is that springing from the pollution attaching to certain callings; while the chief restrictions upon inter-marriage depend upon social position rather than upon tribe or caste. The Cis-Indus Salt Range occupies an intermediate position between the two types. The distinction between them is not merely due to the difference of religion which marks the great mass of the population in the east and west; for in the eastern portion of the Province Islám has, if anything, tended to tighten the bonds of caste, and the convert retains unimpaired the standing, name and prejudices of his caste, while throughout the Punjab the life of the people is regulated by tribal and social rule and custom rather than by any prescriptions of religion. The explanation must be sought in the fact that while society in the Eastern Punjab is modelled upon the type which prevails throughout the greater part of India, the people of the west have already followed the example of the frontier nations with whom they are in contact—nations whose tribal and social restrictions are far more loose than those of the inhabitants of India.

The Pathán, Bilúch and allied Races.

The great Bilúch and Pathán nations, together with a few tribes closely assimilated to the latter by long association with them, hold the countries lying west of the Punjab, the whole length of our western frontier between the Indus and the hills, and a strip of country along the left bank of the Indus. The southern border of the Dera Ismail Khan táhsíl roughly marks the trans-Indus boundary between them, while on this side of the Indus the Bilúchís stretch somewhat further north than on the other. Both are foreigners in the Punjab proper. Among both the tribal organization still survives, in parts at least, in the most complete integrity, and affords an example of one extreme of that series which terminates at the other in the compact village communities of our eastern district. Each, while held together by the traditions of community of blood, includes many affiliated tribes of undoubtedly, and sometimes of admittedly, foreign origin; both are, at least in their native mountains, still half nomad and wholly barbaric.

The Bilúch.

The Bilúch claims Arab origin, but speaks a Persic tongue, while authority seems to incline towards giving him Turcoman descent. His tribal organization, which exists in the Punjab only among the tribes of the trans-Indus Deraját, is based upon a sort of limited monarchy of the Chiefs; he is hospitable, courageous, faithful to his word, and frank and open in his manner. He is a Mussalmán by profession, but a bad one by practice. About the middle of the

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The Bilúch.

15th century the Bilúchis, who had some 500 years earlier occupied the western confines of the Lower Sulemáns, moved northwards and eastwards into the Punjab along the mountains and the Indus Valley, expelling Patháns from the former, and subjugating the Jat inhabitants of the latter. In 1555 a large body accompanied Humáyún in his victorious re-entry into India, and so obtained a footing in the Punjab proper, scattered over which their descendants are still to be found. Besides their tribal territory, which is confined to the Sulemáns and the tract immediately below them, they constitute a large proportion of the population on the Lower Indus, and on the right banks of the Sutlej and Chenab near their junction with that river, and hold all the south-western portions of the Dera Ismail *thal*; while they are found in considerable numbers along the middle valleys of the Sutlej, Ravi, Chenab and Jhelum.

The Patháns.

The nation which occupies the Upper Indus call themselves Patháns from their language, while they are known in Persian as Afgháns from the name of their country. The main stock of the nation is probably Aryan, but a branch of it claims Jewish descent, while the great Ghilzai section and many of the minor tribes are probably Mongol, and other tribes are admittedly Arab. Patháns occupied the Pesháwar Valley about the 15th century of our era, expelling the Dilazáks and other Indian tribes who inhabited it. The Upper Sulemáns and the eastern extremity of the Hindú Kúsh have probably always been held by Patháns; but their descent from the hills into the plain has for the most part taken place within the last two or three centuries. They now occupy the whole tract west of the Indus as far south as the Bilúch border, while on this side of the river they hold much of the Chach country in Hazára and Ráwalpindi; they have considerable colonies on the left bank of the Indus till it finally leaves the Salt Range, and they occupy the northern portion of the Dera Ismail *thal*. The Pathán is essentially democratic in his tribal organization, the authority vesting in the *jirga* or Council of Elders. He is, save where mollified by our rule, and by the agricultural life of the plains, a barbarian of the purest type. He is a bigoted Muhammadan, and is more turbulent, more treacherous, more bloodthirsty, and more fanatical, than the Bilúch; but, like him, he is distinguished by manly independence of character and boldness of bearing.

Allied races.

The races allied to the Patháns are the Dilazák, the Tájik, the Tanauli, the Hazára, the Jadún, the Swáti, and the Shilmáni, most of which are found in Hazára, and none of which require separate description.

The Jat, Rájpút and allied Castes.

Jats and Rájpúts comprise no less than 26·9 per cent. of the total population of the Punjab, which is indeed the peculiar home of the Jat. The former are commonly held to be Indo-Scythians, while the latter are certainly Aryan in the main. But in most parts of the Punjab at least the two are so intimately blended together into a common stock that it is wholly impossible to draw any definite line of demarcation between them; and it is difficult to avoid the conclusion that the distinction is social rather than ethnic; that those families of that common stock whom the tide of fortune has in days gone by raised to political importance have become Rájpúts almost by mere

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The Jat, Rájpút and allied Castes.

virtue of their rise; and that their descendants have retained the title and its privileges on the condition of strictly observing the artificial rules by which the higher are distinguished from the lower castes in the Hindu scale of precedence, while those who have transgressed these rules have fallen from their high estate and ceased to be Rájpúts. And though the joint Jat-Rájpút stock may be in the main Aryo-Scythian, it now almost certainly contains not a few tribes of aboriginal, and perhaps some of foreign, extraction.

The Jat.

The Jat is in every respect the most important among the peoples of the Province, of which he is the peculiar and most prominent product. He is the husbandman, the yeoman, the revenue payer *par excellence* of the Punjab. He is more honest, more industrious, more sturdy, and no less manly than the frontier tribes, and is of all our races the most independent and self-willed, though not as a rule turbulent. There are, however, Jats and Jats. The puny Bágri Jat of the Rájpútána border contrasts strongly with the stalwart husbandman of the Central Punjab; while on the Lower Indus the name of Jat is applied to all Mussalmán cultivators who are not Pathán, Bilúch, Arab or Moghal. The Jats are especially numerous in the Sikh Districts and States which occupy the eastern centre of the Punjab, in the south-eastern districts, and in the Deraját. Under and among the hills, and in the Ráwalpindi Division, Rájpúts take their place; while on the Indus, both upper and lower, they are almost confined to the immediate riverain and the cis-Indus tracts. The Jats of the Indus are probably still in the country which they have occupied ever since their first entry into India; while those of the western plains have almost without exception come up the river valleys from Sind or Western Rájpútána. The Jats of the western and central submontane tracts have also in part come by the same route; but some of them retain a traditional connection with Ghazni,* and many have their origin from the Jummoo hills. The Jats of the Central and Eastern Punjab have also in many cases come up the Sutlej Valley; but many of them have moved from Bikanír straight into the Málwa, while the great Central Plains themselves are probably the original home of many of the Jat tribes of the Sikh tract. The Jats of the south-eastern districts and the Jumna zone have for the most part worked up the Jumna Valley from the direction of Bhartpur, where a colony of Jat emigrants from the banks of the Indus settled in the time of Aurangzeb; but some few have come in eastwards from Bikanír and the Málwa.

The Rájpúts.

The Rájpúts of the Punjab differ little, if at all, from the Rájpúts of Rájpútána. Pride of blood is their strongest characteristic. They are lazy and poor husbandmen, and much prefer the care of cattle, whether their own or other people's, to agriculture; looking upon manual labour as derogatory and upon the actual operation of ploughing as degrading. They may be broadly divided into four groups: first come the Rájpúts of the Delhi territory and the Jumna Valley, for the most part belonging to the two great tribes of Chauhán and Túnwar, which gave Delhi its most famous

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* Perhaps the ancient Gajnipur, the site of modern Ráwalpindi.

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The Rájpúts.

Hindu dynasties. Next follow the Rájpúts of the river valleys of the western plains, many of them hardly, or not at all, to be distinguished from Jats, and belonging for the most part to the Bhattís of Jaisalmír and Bikanír, and their Punwár predecessors. The third group is the Rájpúts of the western hills and the Salt Range tract, comprising both dominant tribes of proud position, such as the Janjúas and mongrel Rájputs from the Jummoo hills, and either descended from the Jadúbansi dynasty of Kashmir, or belonging to a group of tribes, apparently of Punwár origin, which now hold the hills on either bank of the Jhelum. Finally, we have the Rájpúts of the Kángra hills, of whom the Katoch may be taken as the type, so ancient that their very origin and advent to their present abodes are lost in the past; and the Rájpúts of the lower hills which fringe the Punjab Himalayas. In the central Sikh tract Rájpúts are few, and the few there are unimportant; for under the Sikhs the Rájpút was overshadowed by the Jat, who resented his assumption of superiority and his refusal to join him on equal terms in the ranks of the Khálsa, deliberately persecuted him whenever and wherever he had the power, and preferred his title of Jat Sikh to that of the proudest Rájpút. So again on the frontier, Rájpúts are insignificant both in number and importance; for the dominion of the Pathán and the Bilúch, and the prevalence of Muhammadan feelings and ideas have placed Indian origin at a discount, and have led the leading families who belong to neither of these races to claim connection, not with the Kshatriyas of the Sanskrit classics, but with the Moghal conquerors of India, or the Qoreshi cousins of the Prophet, insomuch that even admittedly Rájpút tribes of famous ancestry have begun to follow the example.

Castes allied to the Rájpúts.

The Thákars, Ráthís and Rawats stand in that order between the Rájpúts proper of the Himalayas and the Kánéts and Ghiraths, who form the peasantry of that tract. But the series is practically continuous, and it is almost impossible to define where any term in it ends and the next begins. The Thákar is certainly a Rájpút by origin, though not accepted as such, owing to his having lost status by neglect of social rules; while the Rawat of the lower is with difficulty distinguishable from the Ráthi of the higher ranges.

The Gújar.

The Gújar is the tenth largest caste in the Province. They appear to have entered India from the Pesháwar Valley, probably about the commencement of our era, and spread eastwards along the hills. They belong in the Punjab to the lower ranges and submontane tracts along the whole length of our northern border; and, though they have spread down the Jumna in considerable numbers, they are there almost confined to the riverain low-lands. In the higher mountains they are almost unknown. Gujrát is their head-quarters; and in that district they form 13·5 per cent. of the population. In the hills they are essentially herdsmen; while even in the plains they are bad cultivators, and prefer tending cattle to following the plough.

Minor Dominant Tribes.

These are tribes which, like those already described, are, or have been, dominant in parts of the Punjab, but are not so numerous and so widely spread as to rank with the great races. On the frontier and throughout the Salt Range tract their tendency is to claim

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Minor Dominant Tribes.

Arab or Moghal, and throughout the rest of the Punjab Rájpút, descent, while in the Western Plains and Deraját they are often classed as, and hardly to be distinguished from, Jats. They may be divided into three groups. In the Salt Range tract we have the Karráls of Hazára, the Gakkhars of the northern cis-Indus portion of the tract, the Awáns of the range itself, and the Khattars who lie between them. In the Western Plains we find the Khokhars of Jhang and Shahpur, one of the most widely spread of the Punjab tribes, now claiming in the west Arab descent, although recognized in the east as Rájpúts, which they almost certainly are; the Kharrals and Khatías of the Ravi, the latter being the lineal descendants of the Kathæi, who, in their stronghold of Sangála, so stoutly resisted the victorious army of Alexander; and the Daudpútras of Baháwalpur, to which State they gave at once a founder and a dynasty. In the Eastern Plains the group is represented by the Dogars of the Upper Sutlej and Beas; the Rors of Thanesar, whose home is on the great battlefield of the Mahábhárat; the Tagas of the Lower Jumna, probably the descendants of the Scythian Takas, with a snake for their totem, the tradition of whose defeat and slaughter is preserved in the story of King Janamajáya's holocaust of serpents; and the Meos and Khánzádahs of the northern Aravalís, probably of aboriginal origin, and the latter standing with respect to the former in a relation similar to that already described as existing between Rájpúts and Jats.

The Minor Agricultural and Pastoral Tribes.

The tribes of this group, while important both in point of numbers and as including the most skilful husbandmen of the Province, very generally hold an inferior position among the agricultural community, and seldom, if ever, occupy the position of the dominant tribe in any considerable tract of country. The group as a whole is to be found in largest numbers in the fertile districts of the Eastern Plains and submontane tract, and in the hills where the proud Rájpút refuses to plough. It is least numerous in the Deraját, where all cultivators of this class are included under the comprehensive name of Jat. It may be divided into four classes. First come the widely-distributed market-gardeners proper or growers of vegetables, degraded by their occupation, and represented by Málís in the Jumna zone, Sainís in the eastern submontane, Bághbáns or Malíárs in the Salt Range tract, and Aráins almost throughout the cis-Indus Punjab. The last caste is the most numerous, and appears to have entered the Punjab from the Lower Indus. The second class consists of the Kánéts and Ghiraths, the low-class cultivators of the hills, probably of aboriginal stock, with a considerable admixture of Aryan blood. The Ghiraths are found in Kángra proper and the hills below it; while to the east the Kánéts take their place. The third class includes the Kambohs, probably allied to the Aráíns, who are found throughout the northern portion of the Eastern Plains and in the middle valleys of the Sutlej and Jumna; and the Mahtams of the central submontane and the whole valley of the Sutlej, who are probably of aboriginal stock, being in many parts still semi-nomad. The fourth class includes the Ahírs of the south-eastern portion of the Delhi territory, where they once enjoyed considerable local importance, who have in the Punjab largely abandoned their

hereditary occupation as herdsmen in favour of agriculture; and the Gaddís of the Chamba Himalayas, a purely shepherd race and probably of Khatri origin.

Foreign Races.

The principal castes or races of the Punjab which bear titles denoting foreign origin are: the Sayad, the Sheikh, and the Moghal. But it is almost certain that a considerable proportion of those who bear these names have no real right to them; for in the Muhammadan portions of the Province every section of a tribe that begins to affect peculiar sanctity or social exclusiveness presently claims Arab or Moghal descent; while every convert to Islám, whose original caste is not so honourable as to be worth retaining, calls himself a Sheikh. "Last year I was a weaver: this year I am a Sheikh: next year, if prices rise, I shall be a Sayad." There are, however, a certain number of true Moghals scattered over the Punjab, more especially in the Salt Range tract through which the route of the Moghal armies lay; while in the south-west of the Province there are many colonies of true Qoreshís, descendants of the Arab apostles who converted the inhabitants of those parts, and still possessing considerable spiritual influence with the people.

The Priestly Classes and Ascetic Orders.

The Brahman is by far the most important of the priestly group, and, except the Sayads already discussed, the only one that requires separate notice. The proportion of Brahmans reaches its maximum in the Himalayan tract, where it rises as high as 13 to 15 per cent., and steadily changes with the prevailing religion, Brahmans being almost unknown in the Western Plains and beyond the Indus. They have no territorial organization, having accompanied their clients in their wanderings and settled with them in their new homes. The Punjab Brahmans belong, for the most part, to the Gaur and Sársút sections of the caste—the former lying east and the latter west of a line which may be roughly drawn north-east and south-west through Simla and Patiála. The great majority of the Brahmans of the Punjab are Levites rather than priests; they hold and cultivate large areas of land; they exist chiefly to be fed as a religious act, and they possess singularly little true spiritual influence. The ascetic orders include, besides the true members of the regular orders, who are practically the spiritual guides of the people, a vast number of mendicant vagabonds, who lead a lazy and dissolute life under the cloak of religion.

The Minor Professional Castes.

The position of this group is somewhat difficult of definition. Many of them are in some measure allied to the priestly classes; they have functions to perform in connection with weddings and similar ceremonies; they receive customary fees for the performance of those functions; and they are invested with a sort of *quasi*-sacred character. On the other hand, they have many points in common with the menials; their social status is very low, and many of them are retained by the villages on the same footing as the ordinary village servants, their rights and duties being regulated by custom. The castes of the group may be divided into three classes—the Nái, Bhát and Mirási, who are real village servants, though of a very special character; the Jogís and Ráwals, who are for the most part astrologers and semi-religious; and the Bahrúpías and Bhánds, who are actors and storytellers, and purely

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professional. The Nái is not only the barber, but also the messenger on formal occasions, the go-between in marriage contracts, and the leech or surgeon of the country; the Bhát and Mirási keep up the genealogies of the land-owning classes; while the Jogí and Ráwal are fortune-tellers and magicians of the lowest possible class.

The Mercantile Castes.

The mercantile class may be divided into five groups, the first consisting of Banyas, Dhúnsars, Bohras, and Pahári Mahájans; the second of Súds and Bhábras; the third of Khatrís, Khakhas and Bhátías; the fourth of Aroras; and the fifth of Khojahs and Paráchas. The first, or Banya group, is almost confined to the eastern and south-eastern divisions and to the central Native States. West of Lahore they are practically unknown. The second, or Súd and Bhábra group, is found only in the districts that lie under the hills on the northern border of the Province, from Umballa to Ráwalpindi. The third, or Khatri group, constitutes a large proportion of the mercantile classes of all the centre and, excluding the frontier, of the north-west of the Province. The fourth, or Arora group, have the Mooltan and Deraját Divisions and Baháwalpur almost to themselves, extending also into Pesháwar and Kohát, and crossing the Sutlej in Sirsa to meet the Banya group of the east. Finally, the fifth, or Muhammadan group, is confined to the central and western districts and the Salt Range tract. On the whole, this class constitutes 7 per cent. of the population of the Province. But in the districts of the Mooltan and Deraját Divisions and in Baháwalpur the proportion rises to from 11 to 17 per cent. This, however, is due, not to the fact that a larger proportion of the population of these parts is engaged in commerce, but to the peculiar versatility of the Arora of the south-western Punjab, who is a trader first indeed, but after that anything and everything. The Banyas of the Punjab are for the most part Agarwál, though a few Oswáls are to be found on the Rájpútána border, and there is a considerable colony of Mahesrís in Amritsar. The Bhábras appear to be a purely Punjab caste, and are almost without exception Swetámbára Jains. The Khatrís, who gave Sikhism its founder, are also peculiar to the Punjab, and are very superior to all other trading classes in manliness and independence, being described by Sir George Campbell as "one of the most acute, energetic and remarkable races in India." Much of the literate work of the Punjab is in their hands. The Aroras, whose home is on the Lower Indus, are perhaps closely allied to the Khatrís, to whom they are inferior, both mentally and physically, though they exhibit a versatility which is remarkable in a mercantile caste.

The Pedlers and Carriers.

The only castes of this group that call for notice are the Banjáras and Labánas, the travelling traders of the submontane tract, the former being found in the east, and the latter in the west; while there is a considerable colony of Labánas on the Lower Indus. The two castes are probably the same people under different names; and both appear to be of aboriginal stock largely supplemented by accretions from other and higher castes.

The Vagrant, Menial and Artizan Castes.

This group of castes forms in many respects one of the most interesting sections of the community. Politically they are unimportant; but they include the great mass of such aborigina

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The Vagrant, Menial and Artizan Castes.

element as is still to be found in the Punjab; and while the industries of the Province are almost entirely in their hands, an immense deal of the hardest part of the field work is performed by them. It is probable that most of these lower menial castes have their origin in vagrant aboriginal tribes who have settled down, and, abandoning the most uncleanly of their habits, have risen in the social scale; but it is almost certain that most of them have been reinforced by sections of the higher castes who have sunk by the converse process. Precisely the same process may still be seen in operation, sections of the various castes abandoning a lower for a higher occupation in a series which runs somewhat in this fashion: gipsies and vagrants, scavengers, leather-workers, weavers—and the rise in position is often accompanied or preceded by a change of religion, the impure and semi-aboriginal form of Hindúism, which rules the practice of the outcastes, being abandoned for Sikhism or Islám. Even so, the new converts are often hardly accepted as belonging to the faith by their fellow-believers, even though they abandon those occupations or habits which are held to be most polluting. This tendency to change of occupation makes the lines of demarcation between the several castes exceedingly indefinite; and the castes themselves often consist of merely the followers of specific occupations, and can hardly be called true castes. In this class are included the village menials, which form so peculiar a feature of Indian rural economy, their services and their dues being alike fixed in nature and amount, and regulated by custom instead of contract.

The Vagrant and Criminal Castes.

The whole of these classes put together do not constitute quite one per cent. of the population of the Punjab. But they present many points of singular interest, while their criminal habits render them administratively important. They are probably all aboriginal, and most of them eat impure animals, and are, with the scavengers, the hereditary workers in grass, straw and leaves. They may be roughly divided into vagrant, criminal, and gipsy tribes. The principal castes are, among pure vagrants, the Ods and Beldárs or navvies of north-western India, and the Changars of the Central Punjab, who have been doubtfully identified with the Zingári of Europe; among the hunters, the Baurias of the middle Sutlej, the Aherís and Thorís of our eastern Rájpútána border, the Sansís of the Eastern Plains, and the fisher tribes of Jhabels, Kehals and Mors found in the south-west of the Province; among the criminal tribes, the Mínas of Gurgaon and the Harnís of the submontane; and among the gipsies, the Nats, Bázígars, Pernas and Kanjars, and the Hesís of the hills, all of them wandering minstrels, acrobats and prostitutes.

The Scavenger Castes.

The Chúhras, known in the west of the Province, when Mussalmáns, as Musallís and Kutánas, and in the Sikh tract, when Sikhs, as Mazbís, are the fifth largest caste in the Province. Like the vagrant tribes, they work in grass and straw. Many of them have abandoned scavenging and the eating of carrion with their change of religion, and taken to leather-work, and even to

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weaving. Like all menial castes, they are less numerous on the Indus than elsewhere, while they are found in greatest numbers in the Central Punjab, where they take a very large share in the labour of agriculture.

The Leather-workers and Weavers.

The leather-making castes so often abandon their hereditary occupation for weaving, especially when Sikh or Mussalmán, that it is impossible to separate the two classes. The Chamár, known as Rámdásía when Sikh, and as Mochí when Mussalmán, is the great leather-working caste; and in the east of the Province takes the same part in field work as does the Chúhra in the centre; and it is there that he forms the largest proportion of the population. Taking Chamárs and Mochís together, they are surpassed in number by only Jats and Rájpúts. The great weaving caste of the Punjab is the Juláha, or, as he is commonly called in the villages of the west, the Páoli. It is probable that the great mass of the caste belongs to the same stock as the Chamár, though it is constantly receiving accessions from above, weaving forming the lowest occupation, adoption of which does not pollute its followers. The weaving of wool is chiefly in the hands of the small Gadaría or shepherd caste.

Watermen, Boatmen and Cooks.

The great class of water-workers, from whom it is impossible to separate cooks, probably belong to one and the same stock, the distinction between them being purely occupational. Being essentially fishermen and watermen, they are most numerous in the western and central districts which are traversed by the great Punjab rivers; where, too, they assist largely in agricultural labour, besides finding more extensive occupation as cooks among a Mussalmán population with no prejudices against eating food prepared by others. The water-carrier, fisherman and cook is known as Jhínwar or Kahár in the east of the Province; as Máhra, when a Hindú, in the centre; and as Máchhi, when a Mussalmán, in the centre and west. The boatman is known as Malláh everywhere except on the Indus, where he is called Moháua. The Bhatyára or cook shop-keeper, and the Bharbhúnja or grain-parcher, are smaller castes of the class.

Other Artizans.

It is impossible to separate the blacksmiths from the carpenters. In some parts of the Province the same man follows both occupations, while in most the two castes freely inter-marry. The class is largely recruited from above, and has probably been formed for the most part in this manner. The Kumhár or potter occupies a very low position in the social scale, and, with the artizan castes already described, completes the list of the village menials proper. He is most numerous where irrigation from wells is most largely practised. The Dhobi or washerman, the Darzi or tailor, the Chhímba or calico-printer, the Lílári or dyer in blue, and the Rangrez or dyer in red, constitute a group separated only by distinction of occupations, which are all combined by the Charhoa in the south-western districts. The other artizan castes require no separate notice. The Súnár or silversmith is in the villages almost as much a pawnbroker and money-lender as a craftsman; while

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the Téli or oilman can hardly be separated from the Pénja or cotton-scutcher, and the Qassáb or butcher, all three occupations being commonly followed by the same person.

The Menials of the Hills.

The organization of the menial and industrial classes in the Himalayas and the low hills at their foot differs considerably from that which obtains in the plains. In the former, the whole class is very largely one and the same, the members composing it being differentiated only by the occupations which they follow, and the class itself being considered impure and outcast; and this is more markedly the case the further we penetrate into the hills. In the low hills the Barára and Batwál perform general menial service, the Meg weaves and works in leather, and the Dúmna scavenges and works in grass; while in the higher hills the Koli, Dági, and Chanál, as they are called almost indifferently, perform all menial offices.

SECTION C.—LAND TENURES.

Land Tenures.

The subject of land tenures, in a Province of which the various parts differ so widely both physically and in respect of the races which inhabit them, as in the Punjab, is one which it is almost impossible to treat satisfactorily in the brief space that can here be allotted to it. The Settlement Reports of the Province contain full and minute information on the subject, and the student of land tenures in the Punjab can obtain a thorough knowledge of them only by a careful study of these Reports. This is particularly the case as regards the land tenures of the frontier districts of the Province, in which examples of peculiar tribal tenures are to be met with which can hardly be explained with brevity and correctness. These are generally tinged with a feudal spirit, and often take the form of rights of over-lordship, or claims to receive service retained by tribes which are or were once dominant over other bodies of cultivators who are now sub-proprietors. They are further complicated by the fact that the real measure of proprietary right consists often, not of the land, but the water which irrigates the land. The Settlement Reports of the Hazára, Pesháwar, Bannu, Dera Ismail Khan and Dera Ghází Khan districts contain detailed accounts of all the existing tenures, which often vary in the most extraordinary way from tract to tract, and even from village to village.

General Tenures.

A fuller sketch of the general tenures of the Province will be found in the Directions to Revenue Officers, edited by Mr. Barkley (pages 39—52), and in Mr. Baden-Powell's Manual of the Land Revenue Systems and Land Tenures of British India (pages 395—425), and Mr. Tupper's Customary Law, Volume II (pages 10—37). The account here given is reproduced, with a few slight additions and alterations, from that written by Mr. Barkley for the Administration Report of 1872-73. The following table shows the number of estates and the area held under the various main types of tenure :—

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General Tenures.

Nature of Tenure.	Number.	Area in Acres.
Zamíndári estates held by individuals of families	1,695	2,690,994
Village communities paying in common	3,392	2,778,920
Village communities divided upon ancestral or customary shares subject to the law of inheritance.	4,088	4,600,559
Village communities in which possession is the measure of the right in all lands.	8,568	15,036,573
Village communities in which the lands are held partly in severalty and partly in common.	16,972	25,861,787
Grantees or lessees of British Government	1,584	1,772,342
Landholders who have redeemed the revenue	63	51,001
Purchasers of Government waste land	64	17,078
Government waste unassigued	...	10,216,872
Total ...	37,659	63,026,126

Proprietorships.

Taking the Province as a whole, it may be estimated that between one-fifth and one-sixth of the area is the property of Government, while upwards of four-fifths belongs to private owners.* The greater part of the area belonging to Government is, however, little better than a desert, and could not profitably be brought under cultivation without the aid of extensive works of irrigation, some of which are now under consideration. Some of the more favourably situated portions are preserved as forest or grazing lands, and others are held under lease from Government for purposes of cultivation; but almost the entire cultivated area of the Province is included in the lands of private owners.

Releases.

These lands are held subject to the payment of land revenue to the State, or to grantees holding from the State, and this revenue at present exceeds Rs. 2,36,50,000 per annum, of which more than Rs. 29,50,000 are received by assignees who had, on various grounds, claims to consideration from Government. In some cases these assignments are of the nature of the release of the revenue of lands belonging to the assignees, but they have no necessary connection with proprietary right; and in the majority of instances the grantees are merely entitled to receive the revenue payable to Government, the amount of which is limited in the same way as if it were paid direct to Government.

Rights of Pre-emption.

The great mass of the landed property in the Punjab is held by small proprietors, who cultivate their own land in whole or in part. The chief characteristic of the tenure generally is that these proprietors are associated together in village communities, having to a greater or less extent joint interests, and, under our system of cash payments limited so as to secure a certain profit to the proprietors, jointly responsible for the payment of the revenue assessed upon the village lands. It is almost an invariable incident of the tenure that if any of the proprietors wishes to sell his rights, or is obliged to part with them in order to satisfy demands upon him, the other members of the same community have a preferential right to purchase them at the same price as could be obtained from outsiders.

* It is necessary to observe that the number of holders or shareholders shown in all Government returns is rather the number of separate holdings and shares in such holdings than of proprietors—a person who has two distinct holdings, or shares in such holdings, being counted twice over.

Zamíndári Tenures.

In some cases (technically known as zamíndári tenures) all the proprietors have an undivided interest in all the land belonging to the proprietary community; in other words, all the land is in common, and what the proprietors themselves cultivate is held by them as tenants of the community. Their rights are regulated by their shares in the estates, both as regards the extent of the holdings they are entitled to cultivate, and as regards the distribution of profits; and if the profits from land held by non-proprietary cultivators are not sufficient to pay the revenue and other charges, the balance would ordinarily be collected from the proprietors according to the same shares.

Separate Holdings.

It is, however, much more common for the proprietors to have their own separate holdings in the estate, and this separation may extend so far that there is no land susceptible of separate appropriation which is not the separate property of an individual or family. In an extreme case like this the right of pre-emption and the joint responsibility for the revenue, should any of the individual proprietors fail to meet the demand upon him, are almost the only ties which bind the community together. The separation, however, generally does not go so far. Often all the cultivated land is held in separate ownership, while the pasture, village site, roads, ponds or tanks, &c., remain in common. In other cases the land cultivated by tenants is the common property of the community; and it frequently happens that the village contains several well-known sub-divisions, each with its own separate land, the whole of which may be held in common by the proprietors of the sub-division, or the whole may be held in severalty, or part in separate ownership and part in common.

Pattidári Tenures.

In those communities (technically known as *bhyáchára* and *pattidári*) with partial or entire separation of proprietary title, the measure of the rights and liabilities of the proprietors varies very much. It sometimes depends solely upon original acquisition and the operation of the laws of inheritance; in other cases definite shares in the land of a village or sub-division different from those which would result from the law of inheritance have been established by custom; in other cases reference is made not to shares in the land, but to shares in a well or other source of irrigation; and in the majority of cases in the east and south-east of the Punjab no specified shares are any longer acknowledged, but the area in the separate possession of each proprietor is the sole measure of his interest. It is sometimes the case, however, that while the separate holdings do not correspond with any recognized shares, such shares will be regarded in dividing the profits of common land, or in the partition of such land, and wells are generally held according to shares, even where the title to the land depends exclusively on undisturbed possession.

Redistribution of Pattidári Tenures, Pathán system of Vesh.

In some cases the separate holdings are not permanent in their character, a custom existing by which the lands separately held can be redistributed in order to redress inequalities which have grown up since the original division. Between the Indus and the Jumna this custom is rare, and is probably almost entirely confined to river villages

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which are liable to suffer greatly from diluvion, and have little common land available for proprietors whose separate holdings are swept away. Even in river villages it is often the rule that the proprietor whose lands are swept away can claim nothing but to be relieved of his share of the liabilities of the village for revenue and other charges. Trans-Indus, however, in the tracts of country inhabited chiefly by a Pathán population, periodical redistribution of holdings called *vesh* was by no means uncommon, and the same is stated to have been formerly the case in some of the villages of the Pathán ilaka of Chach, Cis-Indus, in the Ráwalpindi District. The remarkable feature in the redistributions Trans-Indus was that they were no mere adjustments of possession according to shares, but complete changes of property between one group of proprietors and another, followed by division among the proprietors of each group. Nor were they always confined to the proprietors of a single village. The tribe, and not the village, was in many cases the true proprietary unit, and the exchange was effected at intervals of 3, 5, 7, 10, 15 or 30 years between the proprietors residing in one village and those of a neighbouring village. In some cases the land only was exchanged; in others the exchange extended to the houses as well as the land. Since the country came under British rule, every opportunity has been taken to get rid of these periodical exchanges on a large scale by substituting final partitions or adjusting the revenue demand according to the value of the lands actually held by each village. The custom is still acted upon only in a few cases, chiefly in the Bannu District, amongst the proprietors of the same village; and there are now no cases remaining in which it would be enforced between the proprietors of distinct villages.

Village Communities.

Throughout the greater part of the Province the organization of the proprietors of land into village communities has existed from time immemorial, and is the work of the people themselves, and not the result of measures adopted either by our own or by previous Governments. Indeed, these communities have sometimes been strong enough to resist the payment of revenue to the Government of the day, and before our rule nothing was more common than for them to decide their disputes by petty wars against each other, instead of having recourse to any superior authority to settle them. But in some localities the present communities have been constituted from motives of convenience in the application of our system of settlement. Thus in the Simla hills and in the more mountainous portions of the Kángra District the present village communities consist of numerous small hamlets, each with its own group of fields and separate lands, and which had no bond of union until they were united for administrative purposes at the time of the land revenue settlement. In the Mooltan Division, again, while regular village communities were frequently found in the fertile lands fringing the rivers, all trace of these disappeared where the cultivation was dependent on scattered wells beyond the immediate influence of the river. Here the well was the true unit of property; but where the proprietors of several wells lived together for mutual protection, or their wells were sufficiently near to be conveniently included within one village boundary, the opportunity was taken

Village Communities.

to group them into village communities. The same course has been followed in some parts of the Deraját Division, where small separate properties readily admitting of union were found. These arrangements were made possible by the circumstance that the village community system admits of any amount of separation of the property of the individual proprietors, and by care being taken that in the internal distribution of the revenue demand it should be duly adjusted with reference to the resources of the separate holdings. They also in general involved the making over in joint ownership to the proprietors of the separate holdings of waste land situate within the new boundary, in which no private property had previously existed.

Quit-rent Payments.

In some cases the village communities, while holding and managing the land as proprietors (*adna malik*), are bound to pay a quit-rent to the superior proprietors (*ala malik*) under whom they hold. The settlement is made according to circumstances, either with the superior proprietor, who collects the Government revenue as well as his quit-rent from the communities, or with the communities in actual possession of the land, who pay the land revenue to Government and the quit-rent to the superior proprietor. In either case, the amount which the superior proprietor is entitled to collect is determined at settlement as well as the amount of the land revenue demand.

Inferior Proprietors.

There are sometimes also proprietors holding lands within the estates of village communities, but who are not members of the communities, and are not entitled to share in the common profit, nor liable for anything more than the revenue of their own lands, the village charges ordinarily paid by proprietors, and the quit-rent, if any, payable to the proprietary body of the village. The most common examples of this class are the holders of plots at present or formerly revenue free, in which the assignees were allowed to get proprietary possession in consequence of having planted gardens, or made other improvements, or because they had other claims to consideration on the part of the village community. In the Ráwalpindi Division also it was thought proper to record old-established tenants, who had never paid anything for the land they held but their proportion of the land revenue and village expenses, and had long paid direct to the collectors of the revenue, but were not descended from the original proprietary body, as owners of their own holdings, while not participating in the common rights and liabilities of the proprietary community. Except in the Jhelum and Ráwalpindi Districts, where a small quit-rent was in some cases imposed, these inferior proprietors, called *málikán kabza*, were not required to pay anything in excess of their proportion of the Government revenue and other village charges. In Gujrát, at the time of the first regular settlement, this class held no less than 10 per cent. of the total cultivated area, and in Ráwalpindi it paid 9 per cent. of the revenue. In Ráwalpindi the persons recorded as proprietors of their own holdings only were in some cases the representatives of the original proprietary body, jágírdárs having established proprietary rights over what were formerly the common lands of the village.

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Chakdárs and Silladárs.

In Mooltan, Muzaffargarh, Dera Ghází Khan, Jhang, and in parts of some other districts in the south-west of the Punjab, a class of proprietors distinct from the owners of the land is found under the name of *chakdárs, silladárs* or *kasúrkhwárs*. These are the owners of wells, or occasionally of irrigation channels, constructed at their expense in land belonging to others. They possess hereditary and transferable rights, both in the well or irrigation channel and in the cultivation of the land irrigated from it, but may be bought out by the proprietor repaying the capital they have expended. They are generally entitled to arrange for the cultivation, paying a small fixed proportion of the produce to the proprietor, and being responsible for the Government revenue. Sometimes, however, the management of the property has been made over to the proprietor, who pays the Government revenue, and the *chakdár* receives from him a fixed proportion of the produce called *hak kasúr:* or a third party may manage the property, paying the Government revenue and the *hak kasúr*, out of which the *chakdár* pays the proprietor's allowance. In Ráwalpindi also there is a small class of well-proprietors in the position of middlemen, paying cash rent to the owner of the land and receiving a grain rent from the cultivator.

Tenants' Tenures.

Tenancies in the Punjab naturally fall into three great divisions, *viz.*, (1st), those which are held by tenants with rights of occupancy under the Punjab Tenancy Act; (2nd), those which are held under decree of Court, lease, or other special agreement; and (3rd), those which are held as tenancies-at-will. These groups may be further sub-divided by the nature of the rent paid, or, in the case of tenants with rights of occupancy, according to the particular section of the Punjab Tenancy Act under which these rights are held. The rents of tenants with rights of occupancy are liable to enhancement or reduction in accordance with fixed rules which are embodied in the Tenancy Act. And so long as the appointed rent is paid, the occupation of the tenant cannot be disturbed. With one exception of small importance, this tenant right is inheritable by male heirs exactly as any other property in land; and subject to certain restrictions it is also transferable, although in practice it is not very often actually transferred. Moreover, next to the proprietors, tenants with a right of occupancy have a pre-emptive claim to purchase any land offered for sale in the village in which their holdings are situated. Tenants-at-will are so far protected that they cannot be ejected save after issue of notice through a Court of Law. These notices are only issued at particular seasons of the year, and opportunity is given to any tenant who wishes either to contest his liability to ejectment or to claim compensation for unexhausted improvements as a condition precedent to relinquishment of the land to do so. The right to compensation is also regulated by fixed rules embodied in the Tenancy Act.

Size of Holdings.

The exact area held by tenants cannot be precisely ascertained, and is besides liable to constant change. Many persons who are themselves proprietors hold lands separately in tenancy; and figured statements thus return tenants with relative exaggeration. The

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Size of Holdings.

following statistics, which are the latest available on the subject, are only approximately correct:—

Nature of Tenure.	Number.	Average area of holding.
		A. R. P.
With right of occupancy paying rent in cash at different amounts	369,849	5 3 13
Ditto paying rent in kind ditto ditto ...	142,221	8 1 4
Tenants holding conditionally	28,417	6 2 17
Tenants-at-will ... { Paying in cash	570,352	5 4 10
Tenants-at-will ... { Paying in kind	526,238	7 0 5
Holders of service grants cultivating the land so held	40,409	1 3 2
Total ...	1,677,486	6 0 4

Rents.

An examination of the statistics will show that the so-called rents in cash consist to a very large extent of the payment by the tenants of land revenue and cesses only.

CHAPTER V.

INDUSTRIES.

Chapter V.

Industries.

Chief Manufactures.

The statistics of manufactures in the Punjab are still far from satisfactory, and any conclusions based upon them must be accepted with great caution. The estimated gross value of the outturn for 1882-83 was Rs. 13,71,00,625.

The following table gives details of the chief manufactures during the last four years :—

List of Chief Manufactures.	1879-80.	1880-81.	1881-82.	1882-83.
	Rs.	Rs.	Rs.	Rs.
Silk	13,36,360	13,68,091	13,69,230	12,23,618
Cotton	2,79,67,090	3,23,17,644	2,87,48,267	3,64,40,025
Wool	11,21,318	12,24,691	12,68,596	14,12,269
Other fibres	3,85,615	4,24.306	3,65 834	5,30,417
Paper	1,71,073	1,86,532	1,77,609	1,77,325
Wood	97,36 934	85.20,189	87,78,440	1,16,41,474
Iron	94,42,705	73,40,482	72,30,381	70,23,806
Brass and copper	12,89,269	16,48,277	16,32,687	16,76,887
Building	42,20,073	70,44,763	42,69,029	47,98,871
Dyes and dyeing	38,22,902	40,39,474	37,42,717	38,16,404
Oil-pressing and refining ...	64,84,430	83,82,612	82,53,778	87,31,657
Leather	1,15,39,611	1,30,03,500	1,36,70,456	1,54,47,312
Pottery	25,11,185	31,26,069	31,15,566	33,34,674
Pashmina and shawls	9,82,131	11,04,642	8,34,315	7,94,049
Carpets	1,34,233	2 03,760	2,16,708	2,61,204
Gold and silver work and jewellery	2,30,73,055	2,74,86,425	2,97,91,885	3,22,30,579
Other manufactures	92,37,579	77,37,629	81,91,979	75,59,654
Total ...	11,34,55,563	12,49,55,466	12,16,57,477	13,71,00,625

The following paragraphs are devoted to a brief account of the different manufactures of the Province and to a sketch of their history and development during the period of ten years which has just closed. This account has been prepared by Mr. B. H. Baden-Powell, C.I.E., at the request of Government. Admirable accounts, prepared by Mr. Kipling of the Mayo School of Art, of the handicrafts practised in each district, will be found in the district volumes of this Gazetteer.

Period to which this Review applies.

The last detailed notice of the manufactures of the Punjab was written in 1872. At that time the results of a detailed enquiry into the natural and manufactured products of the Province, based on the collections sent to the first Exhibition of 1864, had just been published. Between 1864 and 1872 little or no change had taken place, but within the last ten years there can be no doubt that manufactures in the Punjab have developed and in some respects changed considerably. The Exhibition of 1864 almost naturally followed the close of the first decade of Punjab Administration. The organization of the Civil Government, and the supply of the first wants of a new Province in the matter of roads, public buildings and surveys, claimed attention first of all ; but as soon as the most pressing work was accomplished, Sir Robert Montgomery was able to turn his attention to the material wealth of the country, and it was under his auspices that the design took shape to gather together at Lahore a complete collection of all it could produce from its

Chapter V.

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Period to which this Review applies.

fields, its forests and its mines, no less than from its workshops. In 1882, nearly twenty years later, a second Exhibition was held, the collection being this time confined to industrial and art products, and being designed with the special object of testing the progress made since 1864. It was not to be expected that new processes of manufacture would have sprung up as they do with such rapidity in Europe; for the manufacturing industries of the East are handicrafts pursued on ancient and traditional methods, and are specially marked with the conservatism which is proverbial in Eastern countries. Progress was, however, to be expected, chiefly owing to the revival in taste and art-culture which these past years have witnessed in Europe, and which led to a demand for Oriental work, and that in its national and unchanged forms. The Exhibition of 1882 certainly showed that the expectation of progress was not a vain one.

Effect of the European revival of Art on the Punjab Manufactures.

Without going into any detail on the subject of the modern revival of taste, it is necessary, to understand the nature of the development to be recorded in the following paragraphs, to note those principles which are prominent among the recognized doctrines of modern taste. The first is in respect of *colour*, giving preference to tertiary or compound and sober hues for all large extents of surface, leaving brilliant and simple colours to be used as relief and in sparing proportion; the second is the recognition of the true form which design-ornament for all flat surfaces, whether carpet, fabric or paper, should take. In former days manufacturers delighted to depict flowers, animals, birds, and even metallic scroll-work, not only in vivid colours, but in their natural form, shaded to give the appearance of solidity. This is now discarded, and it has become recognized that all natural forms must be conventionalized, *i.e.*, turned into *patterns*, before they can be rightly used for decorating fabrics or carpets. The third and last principle requiring mention is the recognition of the proper use of material and the manner of decoration appropriate to each kind. A new interest has been awakened in all kinds of beaten and pierced work in metal, in wood-carving, and in marquetry and inlay in wood and ivory; and in consequence many neglected methods have been restored, which were remembered to have been once followed in Europe, and which have never ceased to be used in the East. No sooner did such principles begin to command recognition than it was discovered that the best traditional art-manufactures, not only of China and Japan, but of Persia and the East generally, exhibit in a marked degree the very features (especially with regard to the three points above noted) which the art-studies of Europe have recently (we may say) re-discovered. The people of the East seem to have a natural instinct in devising appropriate forms for flat decoration; and, if their power of designing in solid form is less marked (owing perhaps to their restricted use of furniture and vessels in glass and porcelain), their method of conventionalizing and adapting flowers and other ornamental forms, and their excellent ideas of colouring, leave little to be desired. Hardly anything, then, is necessary to secure the development of the best native manufactures beyond keeping the workmen to their own

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Effect of the European revival of Art on the Punjab Manufactures.

national style of work, and recalling their attention to the best specimens of the work of their forefathers. For it is quite remarkable with what perversity a people so richly provided with the materials for good designing will hasten to copy European models, and those none of the best.

The progress made in developing the native art-manufactures was visible on even a casual comparison of the first and second Exhibitions. In 1864, among the few specimens of wood-carving exhibited, the most prominent were a carved chair and two tables* richly and exquisitely decorated, as far as mere handiwork is concerned, but in the worst possible taste both as to form and kind of ornamentation. In that collection the ivory inlay of Hoshiárpur was hardly represented, while the carvers of Bhera, Chiniot and Bhiwáni were unknown. In 1882, on the contrary, a prominent decorative feature of the wood-work court was a splendid series of doors, frames, windows, and cabinets, all in purely native style, and often exhibiting the utmost refinement and natural skill, alike in the delicate cusping of an arch (borrowed from standard architectural forms) and in foliated borders and skilfully chiselled mouldings. Hardly less remarkable was the contrast between the two Exhibitions in the large departments of embroideries, carpets, printed-cottons, and glazed pottery.

Difficulties to be overcome.

The promise of Oriental manufactures has proved to be such that almost the only difficulty now experienced is to overcome the intense apathy and dilatoriness of the craftsmen and to get them to adhere to their own traditional styles, eschewing the bright and gaudy aniline colours† which have already wrought such havoc both in silk embroideries, in carpets and Kashmir shawls, and avoiding their intense love of copying bad European models.‡ It is indeed legitimate and desirable to encourage the manufacturers to *adapt* their own methods to modern furniture, and to extend their *répertoire* by a study of good examples both of natural forms and of patterns used in other countries; and this can be done, and the way of doing it is successfully taught in the Mayo School of Industrial Art (established at Lahore within the last ten years), without sacrificing anything that is distinctive or excellent in the original styles and methods.

The Manufactures of the Punjab—All handicrafts.

The manufactures of the Punjab are all handicrafts. There is nothing resembling the great factory life of European towns, which comes principally from the adoption of steam machinery and the consequent extreme sub-division of labour in the parts and processes of manufacture. Even steam-mills for weaving, one of the most likely class of factories, have not yet been started beyond Bombay.§ A woollen factory, a sugar-mill, and a silk filature, constitute our only factories, and they have been started by Europeans and are worked

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* Figured in "Punjab Manufactures," pages 201, 204, 210.

† It is said that over four millions of ounces of aniline dye-crystals, chiefly the "magenta," and a coarse green and violet, are annually imported into India.

‡ In 1864 a Native Silversmith exhibited with great pride a stiff copy of one of the worst possible designs in the then fashionable electro-silver *épergne* of some London dealer.

§ Such weaving establishments, and especially factories for making European paper, appear to be the most promising and likely kind to be established in future.

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The Manufactures of the Punjab—All handicrafts.

on the European method. When returns are formally made of Native "factories," it can only mean that in a few places a certain number of workmen are congregated together in the same village or *mohalla* (quarter of a town) and work together, perhaps having some system of sharing the gross earnings, and dividing the labour where several stages or processes in the manufacture are well marked by custom or are in themselves inevitable. Examples of such "factories" are to be found in the groups of paper-makers at Siálkot, in a few groups of shawl-weavers, silk-winders, and gold wire-makers at other places.

Division of Labour in Native Manufactures.

The question of factories suggests the subject of division of labour in manufacturing processes—a question about which very little is as yet known, though it is one full of curious interest, involving, as it does, considerations of caste division and also of the relative occupations of the sexes. It is a subject well worthy of investigation. In many trades there is no doubt that the same workman will complete the article in hand, from the first shaping of the raw material down to the last finish of engraving or other ornamentation. But in some trades we have distinct branches. In the gold wire-drawing trade the workman who makes the *kandla* or gilt ingot, the *tárkash* or wire-drawer, the *dabkai*, the man who flattens the fine wire, and the workman who twists the flattened wire on to red or white silk to make gold or silver thread, are all separate craftsmen. So in jewellery, the fixing of gems into their setting is a special trade. In the extensive cotton industry, again, the ginning or separation of the fibre from the seed is separately done, but is commonly practised by shopkeepers, by butchers and oil-makers. The scutching or carding is again separately done. The preparation of the web for the loom is often, but not always, done in the weaver's own family; and so the filling of spools and shuttles with thread is a separate occupation, although no doubt the women of the family largely aid in these preliminary processes.

Combinations of Trades.

In many districts the *mochi* or cobbler combines weaving with his caste-business of making and mending native shoes. The late Census shows that in the Province (including Native States) 674,264 persons (371,716 males and 302,548 females) are engaged in the cotton industry* ; while the tables show 35,625 women and 177 men as engaged in preparing the web only, and 53,290 women whose trade is to charge shuttles with thread for the weavers. Another combination of trades is interesting to notice, because both branches have received a great development in the last few years. The trade of dyeing is often combined with that of printing cotton fabrics with wood blocks. In some places people called *charhoa* appear to combine both these occupations with ordinary washing; but in other places cotton-printing is a separate business. The Census tables show 32,993 persons (26,844 males and 6,149 females) as engaged in cotton-dyeing, and 11,304 (10,199 males and 1,105 females) in cotton-printing. Silk-washing and dyeing (the silk is bleached by sulphur fumes and then dyed) and *pashm*-dyeing are

* Excluding cotton-dyers, cotton-printers, and tent-makers, which are really quite separate trades.

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usually specially conducted, but many dyers dye all kinds of threads and fabrics.

Localization of Manufactures.

Another feature in the manufacturing industries of the Punjab (as in other parts of India) is their frequent exclusive localization. Not only so, but where two or more localities have similar industries the character of the work is distinctive. For example, the turning and lacquering of bed-legs, boxes, toys, &c., is practised at Ferozepore and Kasúr (the same family works at both places), in the Hoshiárpur District, at Pákpattan (Montgomery), and in the Dera Ismail Khan District; but in the former places the ornament is almost entirely done with the chisel; several layers of colour are laid on, one over the other, and the depth of cutting being varied, one or other colour is laid bare, or the cut goes through all and exposes the white wood below. In Hoshiárpur hand-painting on a bright lacquer surface, often enhanced by a substratum of metal foil, is resorted to. The Dera Ismail Khan work, again, is distinguished by its colour, by the use of incised ornament, and by the use of discs of pierced ivory and studs of the same to relieve the work. So, again, the cotton-prints of Rohtak, Lahore, Talamba (Mooltan), Kamália (Montgomery), and Sultánpur (Kapurthala State) are all excellent in kind but quite characteristic, if not absolutely distinct, in style and colouring at each place. Other manufactures are entirely local. In Hoshiárpur only is the ivory and metal inlay done; a peculiar inlay in brass on dark shísham wood (quite unlike the wire inlay of Mainpúri) seems to flourish only in the Jhang District. The curious leather-work with embroidery of strips of white quill is confined to the hills below Simla.

Trade Secrets in Families.

In manufacturing places there are generally to be found certain families that keep up trade secrets or the traditional designs and processes of manufacture. It is believed that the peculiar "majolica" ware of Peshávar is glazed by a lead process, now known only to the makers there. The glaze of other local potteries, *e.g.*, Mooltan and Delhi, is of *frit*, or glass and flint ground together. In Jullundur a descendant of the old decorators of the celebrated Wazír Khán Mosque at Lahore possesses the secret of hard glazing and of many beautiful colours for encaustic tiles not known elsewhere in the Province. In the same way, stone-carvers survive at Delhi (they did some most beautiful work for the Memorial Church there) who claim to be descendants of, and to keep the traditional designs and decorative rules of, the families who, in the 14th century, adorned the Kútab Minár.

Trade Dialects and Nomenclature.

Nearly all the craftsmen have technical names, not only for their tools, but also for every part of their ornamental designs, for each kind of border, form of wreathing, foliage or flower. In trades demanding the transfer of fixed patterns, by a certain series of stitches or threads, to the loom (as in shawl-weaving), the workmen have a complete system of notation and colour and stitch signs arranged as a *memoria technica.** Forms of ornament and patterns being traditional, the native dialects contain separate names for each variety of personal jewellery, whether necklace, earring or bracelet;

* Dr. Leitner has recently published a pamphlet on the terms and signs used by shawl-weavers.

Trade Dialects and Nomenclature.

and so for every form or pattern of woven fabric: such terms as *dopatta*, *lúngi*, *khes*, indicate the form of the cloth according as it is made in one piece or in two to be sewn together (*e.g.*, *dopatta*), or whether to be folded in two or four for use—*dotahi*, *chautahi*. Sometimes the term indicates the pattern, *e.g.*, plain (*sáda*), spotted (*búnd*, *ilácha*, &c.), checked (*chárkhána*), or striped (*dorídár*, *ábshár*, *kalamkár*, &c.), diapered (*búlbúlchashm*), ornamented in various ways, *chándni*, *sardárkhori*, *gúlchaman*, *moth phalli* (patterns like the pods of *moth*), &c.; special terms also indicate that the fabric is woven with side-borders, or fringes, or end-stripes (*palládár*, &c.). Many fabrics are named according to the number of threads in the web (*e.g.*, *painsadi*), or by the stoutness of the thread—single or double twist. Such are the origins of the terms *tín*, *chau* or *panj-tárí*, *yaktára* or *dotára*, *eksúti*, *dosúti*, &c.

Caste and Religion as affecting Manufactures.

Religions or caste differences have occasionally a share in creating local fabrics and forms of vessels, &c. It is not strictly lawful for Muhammadans to wear pure silk; this fact has given rise to the *mashru* or "permitted" fabric, which resembles a striped satin, having a lustrous silk woof on a cotton web. Shújákháni silks made in Baháwalpur and Mooltan have a similar mixture of material, and so also a curious, but not very pleasing, fabric called *súfi*. The forms of brass-plates and other utensils, and even of the bowls of *húkas*, are traditionally varied between Hindús and Mussalmáns. A Hindú brass vessel-maker would generally be unable to produce the graceful *aftába-chilam*, or basin and ewer, used in Muhammadan families for pouring water over the hands after meals. As a rule, also, copper-tinned vessels are not used by Hindús, though they are by Muhammadans. The development of glass and glazed pottery is probably much hindered by the fact that no good Hindú will use an earthen vessel twice for food or drink.

Review of the Chief Classes of Manufactures.

As the manufactures of an Eastern province show so little tendency to change in themselves, it might be thought unnecessary to repeat a description of Punjab manufactures, notwithstanding the progress stated to have been attained during the last few years. It is desirable, however, to render this notice complete in itself; moreover, there has been such a considerable increase of demand for some classes of goods, and such a revival of almost forgotten handicrafts, that there is in fact a great deal to be added to what was written ten years ago.

Cotton Fabrics (woven).

The cotton-weaving industry has been already alluded to, and demands the first notice, as being by far the largest and most wide-spread of all manufacturing industries in the Province, as the figures already given prove. The plain weaving of coarse cloths without pattern or bordering is mostly done in villages, and the fine and more ornamental weaving in towns and cities. Some of the Punjab cotton fabrics are of considerable merit. Various districts have their specialities. Pesháwar has a speciality in fine checked *lúngís* with gold or coloured borders, worn as turbans by all the Mussalmán frontier races. Ludhiána is noted for the variety of its cotton fabrics, many of which are in demand for European wear or household use. *Patkas* (girdle pieces) of every variety, *lúngís*, *khéses*, striped cloth called *gambroon*, twills, jeans, and checks

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Cotton Fabrics (woven).

of several kinds are all to be found. The thick white-twilled (and red or blue-bordered) *chautahi* often worn by agriculturists, and used by other classes as a counterpane or sheet for the native bed or *chárpái*, is a good specimen of native weaving; it is woven on the cross by a loom with four or eight *heddles* (instead of two as in the plain loom, where the threads of the web are simply once raised and lowered for every cross-stroke of the shuttle). The commoner kinds of *khés* and the *chautahi* are best made in Háfizabad, Khusháb, Pákpattan, Sirsa and Sultánpur (Kapurthala), but excellent ones are to be had in most large villages. The *súsi*, or striped cotton fabric, chiefly used for women's clothing, is also a fabric made everywhere, but notably at Batála. Some excellent cloths in a large check of dark blue and white are made at Jhang and elsewhere; and are mentioned as likely to come into demand for export as a pleasing and serviceable floor-cloth. Fine muslin is still only made at Delhi, and a little at Rohtak. A manufacture of fine glazed and close-woven white cloth called *gháti** is now almost confined to Ráhon in the Jullundur District. Of late, however, specimens have been sent from Ludhiána and other Cis-Sutlej places. The fabric, which is the finest texture and most highly finished of native fabrics (not being muslins), is made plain or diapered with small diamond shapes called *búlbúlchashm* (nightingale's eye).

Cotton Carpets.

Cotton carpets are rather largely made. There are two varieties, the cotton *pile* carpet, which is made at Mooltan, and the *dari*, which is woven on a large low loom and truckles a few inches above the ground, and is made like an ordinary plain woven fabric, only with thick thread or cotton string. It is difficult to produce patterns other than stripes, but geometrical designs can be introduced; and if the colours are well arranged, these cool and cleanly carpets are much to be commended. The best are still made in jails; but there are excellent fabrics of the kind to be had at Umballa.

Cotton-prints.

Cotton-printing (with raised blocks cut in some hard dark-coloured wood) has already been alluded to. That of Sultánpur (Kapurthala) is of special excellence, and orders have recently been executed for the South Kensington Museum. The printers of Kamália often introduce quaint decorative forms of men, animals of the chase, horses, &c. The geometrical designs stamped at Talamba (Mooltan) in black, soft green and chocolate are very pleasing. An enterprising printer at Lahore (Amír Bakhsh) now makes pieces well suited for the decoration of walls (*dado* pieces†). At Lahore also is to be found a peculiar print, stamped uniformly on muslin, in one colour (a pale yellow of the "old gold" type); this material is adapted for summer curtains, and even for ladies' dresses when carefully printed. This class of manufacture deserves special notice, as it is a conspicuous instance of the *revival* already alluded to. In 1863 hardly a specimen was seen; now these fabrics are in increasing demand; and as colour and arrangement of design

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* *Gháti* used to be made at Lahore; it is somewhat expensive, and in former days Sikh gentlemen used it for their "white clothes" (*saféd posh*).

† It is significant that they have already invented the suitable term *diwálgír* for the *dado* pieces.

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Cotton-prints.

leave little to be desired, some of them at least (contrary to what was before believed) are permanent and fast in colour. The manufacture is not by any means confined to the places indicated. When making a collection for the Calcutta Exhibition of 1883, more than one new locality came to light; and in some cases it was found that the more delicate portions of the pattern were put in by hand-printing, in the manner of the old Persian cloth decorators. These fabrics, &c., are known among natives by the name of *abra* or *chit*, and the pieces made for covering beds, floors, &c., as *jajam*, *toshak*, &c. They are well adapted for European use and for export.

Silk fabric weaving.

The *silk-weaving* (piece-goods) industry has not largely developed. The *gulbadan*, or striped silk, has no lustre, and is not likely to command an export trade. The same is true of the plain silk, or *daryai;* a variety of this (*dhúpchán*) is "shot" or has a lustre of two colours. The ornamental silks of Baháwalpur and Mooltan—some of them varied with damask patterns and stripes of gold—are likely to be demanded abroad for curtains and furniture. The price, however, is somewhat high. Only 3,842 persons of both sexes are returned in the Census tables as silk-weavers. Amritsar gives nearly half the total, the rest being nearly equally distributed between Jullundur, Lahore and Mooltan.

Silk-rearing in Gurdáspur and Kángra.

The rearing and reeling of silk is carried on in the Gurdáspur and Kángra Districts, but the industry does not seem to prosper.

The Patoli, or Silk-net and Fringe-maker.

This class of silk industries should not be passed by without a notice of the trade of the *patoli*, or *ilákáband*, a class of men (and many women are employed also) who make almost all the small articles in silk that are not loom-fabrics. The chief object is the netted silk string or girdle with tassels so universally worn; but besides these, silk cords and tassels (*sejband*) for tying down the coverlets of beds, silk fringes for horses (*makerna*), silk leashes (*sirdawal*), strings bound with gold thread for necklaces, amulets, &c., silk to plait into maiden's hair (*paránda*), and a whole host of silk gimps, fringes, tassels, edgings, and bead-work; even ornamentation for *néchas* and tubes of *húkas* may come within the scope of the *ilákáband's* skilful fingering.*

Woollen Manufactures.

The Punjab and neighbouring districts still maintain a considerable manufacture of, and trade in, woollen goods. The class, however, contains widely different industries which may be separately mentioned under the heads—shawls, plain *pashm* fabrics, pile carpets, and sheep's and goat's wool fabrics.

Shawls.

The chief *shawl* manufacture is of course that of Kashmir, and is hardly to be included as one of the Punjab manufactures. The trade is one that is not likely ever to receive more than a limited development.† The loom-woven shawl, and even the cheaper hand-worked

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* The Census shows 2,145 persons "silk cord-makers," and a separate head is given to "waistband weavers" with only 76 male and 469 female persons under it.

† The External Trade Report for 1882-83 shows the export of Kashmir shawls, thus (in round numbers) :—

	Value in Rs.
1880-81	21,50,000
1881-82	10,88,000
1882-83	11,81,000

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Shawls.

shawl (in which the pattern is worked on the surface with the needle), are alike too costly in proportion to the effect they produce. The manufacture also has been much injured by the use of aniline dyes for the wool. There is not much hope for the trade, except in cheaper varieties of striped *jámawár*, or in fabrics which have only borders or corner pieces in shawl work. In the Punjab itself, Amritsar continues the centre of shawl-weaving, though the work is not equal in fineness to that of Kashmir. The Census shows the shawl-weavers as close on 12,000 (males). Of these 8,384 are congregated in Amritsar. Ludhiána has about 1,000; Gujrát (where only inferior shawls and edgings are made) has 1,600. The district of Kángra (Núrpur) has 300, and Lahore and Delhi about 100 each. A very few Kashmíri families working at this trade are to be found elsewhere. The favourite forms are the *doshála* or long shawl, the *rúmál* or square shawl, and the *jámawár*, a long piece always in ornamented broad stripes (the older style was white and green). Edging (*kinára*) is woven on a silk web, for stiffness.

Plain fabrics of Shawl Wool.

Plain fabrics of *pashm* or shawl wool are made at Amritsar and Ludhiána. The shawls called *Rámpur chadar* are well known. They derive their name only from Rámpur (Bashahar State), where originally a local fine wool was made into small shawls; but now most of the *Rámpur chadars* are made at Amritsar and of *pashm*. In Ludhiána inferior *chadars* are made, and a good deal of the work is done, not with true shawl wool or *pashm*, but with a fine wool imported from beyond our North-West frontier, called *Kirmáni* and *Wahab Sháhi*. *Pashm* cloths if plain wove are called *alwán* (*yaktára* and *dotára*, according as the thread is single or double twist), and *malída* when fulled or felted, so that the threads are no longer distinguishable.

Carpets.

Carpets have of late years come into great demand, and are one of the manufactures which have benefited by the revival of taste in Europe. Good sober but rich colouring has been restored, and recourse has been had to old Persian models of design. Some magnificent examples, said to have been obtained at Kandahár, have recently been recovered from neglected godowns at Jaipur; and, by the kindness of His Highness the Mahárája, these were sent to the Exhibition of 1882, where they have been copied under Mr. Lockwood Kipling's direction at the School of Art. They exhibit remarkable specimens of both floral and geometrical design, and also of conventionalized hunting (*shikárgah*) patterns. The colouring, mellowed but not faded with age, is beyond praise. As yet, however, the jails have far excelled all other factories, and indeed but for the jails good carpet-making would hardly survive. A local School of Industry at Hoshiárpur and another at Kasúr (Lahore District) turn out fair carpets; but it is impossible, without close supervision, to induce ordinary workmen to make the initial outlay of capital in securing the best wool and dyeing it only in good and permanent colours. As a rule, too, good and traditional patterns to reproduce are not generally available. This may be overcome in time, especially by aid of the School of Art. It should be remembered, however, that carpet-making is not, and never was, strictly indigenous to the

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Carpets.

Punjab. It was locally introduced into the Derajât (where the Bilúchi rugs, sometimes ornamented with shells and executed in a variety of beautiful warm dark reds and blues, are of considerable merit), and perhaps into Mooltan in by-gone years. More recently the manufacture has been carried on with some success at Amritsar.* Imported carpets from Persia, Kabul, Yárkand, &c., are occasionally to be found for sale.

Other Woollen fabrics.

Of ordinary *woollen fabrics*, the hill districts—Kángra (including Kullu) and the Simla States—produce excellent checked and plain shawl-blankets, often with fringes and coloured borders; they also make varieties of narrow woollen fulled cloth called *pattu*. There are occasionally fabrics of goat-hair. The varieties of camel-hair cloth (*bark*, *urmak*, &c.) are all imported from Kabul and Central Asia. The manufacture in the plain districts is almost wholly confined to common black or brown blankets and to the *loi*, a white shawl worn in winter by the middle and better-off classes. The Census shows some 3,721 persons engaged in blanket-weaving.

Embroidery.

As might be expected, the class *Embroideries* is one which also has received a large development in the last few years. In one branch alone, the *phúlkári*, a considerable trade is done. This fabric is, in its origin, nothing but a large sheet, usually of a dull red or dark blue ground colour, worn as a sheet or wrapper by women. It is ornamented with a sprig or other pattern in floss-silk, and often has broad borders at either end. The *phúlkáris* are worked chiefly by the women of agricultural and trading families, and are now in demand for *portières*, curtains and furniture covering. Each district almost has its specialty in pattern of style. Amritsar, Siálkot, Hoshiárpur, Gujránwála, Hazára, the Wazíri country, Rohtak, Hissar, all produce excellent work. In the Eastern Punjab the style of the work is especially characteristic, a fine chain stitch is used in geometrical designs, and in the parts also small pieces of silvered glass are sewn on, producing a very singular and not unpleasing effect. For gold embroideries, Delhi, Lahore and Amritsar are the head-quarters. This work is distinguished as *kárchob*, from the wooden frame on which the fabric is stretched. The pattern is always first raised in relief by a bedding of thick white or yellow thread, and the gold thread, or even gold wire flattened (*sulma-mukesh*), and spangles, are sown over it. Such work is in demand for elephant covers, saddle cloths (*chárjáma*), and *masnads*, carpets and cushions of state. Coloured silk embroidery, with or without gold (when both are employed the work is called *nimzari*), is practised chiefly at Delhi, but also at Amritsar and Ludhiána. A large quantity of embroidery is also done at Amritsar and Ludhiána, in one coloured silk or *pashm*, or shawl wool cloth, the silk being the same colour (but a darker shade) as the ground. White embroidery and a sort of quilting called *sozni* are occasionally met with. The Census tables show 9,118 persons† (5,076 males and 4,042 females) as embroiderers. It is remarkable that it is

* The Census takes no notice of pile carpet-makers as a class.

† Amritsar alone gives 3,757 male and 518 female embroiderers.

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British territory that shows all but 30 of the male workers, while of the female 1,398 are in Native States.

Wood-work—Carving and Inlaid Ware.

Taking the manufactures in the order of their commercial importance, the class of wood-work is one which possesses great interest, and has also been largely developed of late years. Allusion has already been made to the position it occupied in the collection of 1864. It is now known that not only Amritsar and Delhi, but Bhera (Shahpur), Siálkot, Jhang, Simla, Hoshiárpur and Bhiwáni (Hissar) have all excellent and usually characteristic and original manufactures in work. It was an ancient custom to decorate the panels and frames of doors and windows, and also the balconies and other like appendages in native buildings, and a great deal of the best work of the places named still consists of doors with the frames and panels beautifully carved. Often too brass-work or ivory is inlaid with excellent effect on dark wood. The Hoshiárpur work is noteworthy as having risen to considerable commercial importance; it consists of ivory and occasionally brass inlay on *shísham* wood. It is chiefly executed by a group of workers at Basi Ghulám Husain. It is remarkable that at Shahábad (Umballa) a workman has introduced the familiar Bombay inlay—a species of marquetry or *tarsia* known as *piqué*. It consists of fixing with some cement into a bundle a number of thin rods of coloured wood with ivory and angular tin wire; a fine transverse slice is then cut off and embedded in the wood; a small geometrical pattern is thus obtained. In Simla, European furniture has always been the chief object of manufacture, and this has of late markedly improved. The hill districts have the advantage of local supplies of walnut wood, hill mulberry and of Zebra wood (*Pistacia integerrima*), a beautifully grained material, which, however, is very difficult to season; and it cracks and warps, after even years of keeping.

Turned and Lacquered Ware.

Turned ware, and the method of chiselling ornament on lacquered surfaces, have been already alluded to. In many places this chiselling is confined to strips or edging, and the body of the work is mottled in two or three colours obtained by the partial adherence of different colours, produced by light touching or pressure of the colour sticks while the work is revolving on the turner's drum worked with a leather strung bow. The sticks, made up with lac and resin, partly melt by the heat developed by friction; the touches of colour are afterwards blended, smoothed and polished by aid of fine cut edge of bamboo and afterwards with a rag and oil. Hitherto this art has been employed on toys, round boxes, vases and candlesticks; but of late attempts, promising some success, have been made to use it for furniture, in rails and legs of chairs, and couches, and for hanging-shelves, &c. Already the native taste had employed it in this direction, but for the sole purpose of making the low legs of the *chárpai*, or Indian bed. Occasionally low-backed stools called *píri* and spinning-wheels for the richer classes are decorated with lacquer. It is likely that a trade may be developed in lacquered ware when applied to useful purposes.

Cane and Basket work.

The recent fashion for cane and bamboo chairs and couches has to some extent developed this industry. In the Exhibition of 1882 some varieties of work were shown from the Umballa District. Some

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rather pleasing basket work in bamboo slips is done at Hoshiárpur and in some of the Hill States. Straw baskets are made in Hazára, and very nice serviceable basket work from the leaf of the *Chamærops* palm in Bannu. It is the leaf of this palm that yields the fine mat-work of Pesháwar. For flooring, ordinary matting is made of the date palm leaf and from a rush or flag; but the work is rough and coarse, and in no way comparable to the grass matting of Calcutta.

Metal work (Brass and Copper).

There is a great manufacture of *brass vessels* for household use, and some of the forms are of interest. The makers are usually classed into two—the *bhartya* who makes his own alloy, and casts and turns smaller vessels and solid objects, and the *tathyár* who makes larger vessels by hammering on blocks from imported brass and copper sheets. There is a considerable manufacture at Amritsar, at Pind Dádan Khan, Sahíwál (Shahpur), Rewári, Bhiwáni, Jagádhri, Hoshiárpur and Kángra. The metals used are imported brass and copper; a brittle bell-metal called *phúl* or *kánsi*, and *bhart*, an alloy which is valued because sour or acid liquids put into vessels made of it do not spoil. A very little ornamentation is effected chiefly by chasing and engraving, and occasionally by patterns incised into the metal and then filled up with black composition. There is no Punjab work in incrustation like that of brass and silver on copper as in Tanjore and other places: nor have we any *bidri* work. In Kashmir copper chased over with a minute foliated pattern, and tinned, the hollows being filled with black or red in a sort of *niello* fashion, is much admired. Beautiful specimens of work in "teapots" or vases are occasionally picked up; they are of Thibetan or Central Asian origin. In Amritsar an art has newly been brought to light—door panels of exquisitely designed beaten copper-work or *répoussé*. This is capable of great development. A fine specimen was shown at the Calcutta Exhibition of 1883. The Census returns show some 13,776 persons as engaged in brass and other metal work of the class above described.

Cutlery and Gunsmith's work.

There are scattered over several districts a few workmen who are capable of turning out very creditable *cutlery* and gunsmith's work. In Siálkot surgical instruments have been made (with imported steel) of excellent finish—Nizámabad (near Wazirabad) is one centre of cutlery, and knives are made at Bhera in the Shahpur District. The Native States of Jínd and Nábha sent to the Exhibition of 1882 padlocks of a finish and construction that would have done credit to a European workshop. The Census only shows 96 persons returned as cutlers; but the fact is that the class is not really a separate one, and doubtless many men who could work returned themselves as *lohár* (blacksmith), or simply as *mistri*, a term which here applies to a worker not only in wood, but in metal also. Sword blades and knives are made in the Pesháwar District from the fine iron of Bajaur; and rifles are manufactured in Kohát.

Damascening.

The only form of damascening is known as *koftgári*, as its name implies—the art of "beating" gold-wire in delicate patterns traced with a hard steel style on a steel or coloured iron surface. It is confined to Siálkot, Gujrát, and to the workshop of one or

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two survivors of the old Sikh armourers at Lahore. The tendency of the modern work is to become cheap and poor, owing to the habit of the makers in bargaining for goods. The patterns are often too small in detail, and are so spread over the surface that the effect is lost. The School of Art might do a good work in reforming this work and directing it to novel and useful applications. The Census shows only 111 persons devoted to this craft—a number which is probably under the mark.

Gold and Silver ornaments for personal wear.

There is a natural skill to be found almost everywhere among the *súnár* castes in beaten, chased and *répoussé* silver and gold work, and even in filigrain. Most districts therefore produce excellent national silver and gold ornaments. Among the best may be mentioned Hazára, Shahpur, Delhi, Kángra (including Kullu). The curious *babúl* work is still confined to Delhi. It consists of ornaments made up of small globes or hemispheres of gold covered with minute points, so as to give the resemblance of the flower of the *babúl* (Acacia).*

Gold wire-drawing.

Gold wire-drawing and tinsel-making in all its stages is practised chiefly at Delhi and Lahore. The Census shows 1,253 persons engaged in these processes.†

Jewellery.

Except at Delhi work in precious stones is a trade of little importance.

Enamels.

The enamelling of Kashmir in two shades of blue (and occasionally green) is very effective. It is done both on silver, gold, and copper gilt. That of Baháwalpur is in a different style; and some rough enamelling of a sufficiently picturesque character is done in the Kángra District. At Mooltan fair enamelling is done. The varieties of colour, notably the fine ruby colour and white, and the delicate flowering obtained at Jaipur, are unknown in this Province. Turquoise blue and deep blue (from ore of cobalt), a clear dark green, a dull opaque red, and occasionally a crude yellow, are all the colours that are known. The work is all of the kind called *champlevé*, in which the pattern is incised and the hollow parts filled up with composition ground-like paint, which is then fired and fused under the protection of a fine wire cage or cover.

Pottery.

Potters are universal in all northern and central Punjab villages, where the Persian wheel is used on the wells, as the *tind*, or earthen pot for the well gear, is demanded by the thousand. But potteries for other vessels are usually confined to places where there is good clay. The demand for glazed ware is very limited. Hindús could not, from caste difficulties, use it for any purpose connected with food or drinking. Muhammadan families use it, but mostly imported cups and basins; for the native glazed ware, though the glaze is apparently perfect, will not stand any long contact with water. The best glaze is that of Pesháwar. The

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* The laborious process of making it is described at page 186 of "Punjab Manufactures."

† It is remarkable that though Lahore is a known centre of *kandlakashi* (ingot-making and gilding) and *tárkashi* (wire-drawing), the Census table is blank for the city. Possibly the workmen have been included in the 644 persons shown as dealers or makers of gold-thread.

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Delhi glaze is good, but there the clay (from Aúrangabad) is a true though rough porcelain, and the glaze actually combines with the body. In other places the pottery clay, being naturally red when burnt, has to be prepared by a layer of white colour before the ornamentation and the glaze are applied, so that it requires careful working and firing to get the glaze to take hold on the vessel. The Mooltan manufacture (distinguished for bold and effective design in two shades of blue on a white ground) has greatly fallen off owing to the pernicious effects of a large contract which the principal maker undertook. The colours usually produced are limited. The maker at Jullundur possesses the secret of making several beautiful colours, and it is much to be regretted that this man cannot be induced to work.* In other places a turquoise blue (copper) and a dark blue (from zaffre) are both exceptionally good; brown, green, and a disagreeable yellow (lead chromate) are also known. A fine unglazed pottery finished with a gloss of talc powder is made at Rohtak; and some elegant pottery, the surface polished smooth, and decoration applied in oil-paint, has recently been produced in the Hoshiárpur District. A very thin ware is made at Baháwalpur, where also the potters are fond of decorating it with colour, but very rudely.

Glass.

Glass-making is almost unknown. A few makers collect and remelt broken white glass from Europe, and make lamp-chimneys and a few other small articles. A crude greenish glass, not very clear, and full of bubbles, is made in the country, and from this bulb-shaped phials are made in great numbers. These serve for the druggist and also for illuminations; when filled with coloured liquid they are placed in rows with small lamps behind. Glass *chúrís* or bangles and silvered glass globes and beads are made at Karnál and Gurgaon. Recently a glass-blower of Kaithan (Hoshiárpur) has made praiseworthy efforts to produce cups, *húka* vases and small ware in coloured glass, having produced a fair show of colours, dark blue, pale blue, opal white, green, yellow and plum colour.

Leather Manufactures.

Besides the common manufactures of *leather*, such as shoes, water-skins and saddlery, there are some which show artistic skill. The Biláspur State has a trade in articles of black leather, or leather variegated in colour (black, green and red), the whole being ornamented with a stitched pattern done with fine strips of peacock quill. Leather worked in silk or gold thread is also produced at Pesháwar, in the Deraját, and at Hoshiárpur. At Sáhiwál (Shahpur) oil vessels and other receptacles, often of large size (*kúppa*), are made out of raw hide, or out of animal integument boiled to a pulp, and fashioned on a clay block (which is broken up and removed when the exterior is dry). The work is done at other places also. But Sáhiwál is the only town where an attempt is made to ornament the surface with printed patterns. In Kasúr, Pákpattan and Jhang

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* He is occupied in making ordinary glazed ware for barrack use. Efforts to get him to make encaustic tiles, which is his speciality, are almost always unavailing.

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leather *húka* bottles are made, often prettily decorated with coloured leather, and with silver studs and brass ornaments. The preparation of skins of a fine turquoise colour, but inclining to green, is carried on in the Pesháwar District, and red leather and black leather are also well made at various places (in Kángra especially). The tanners of Kángra are skilled in making soft leather, and in preparing furs, so that the hair is uninjured, while the skin is converted into soft white leather. Both in Kángra and Hoshiárpur soft leather, called "sambar," of a toad colour. is made, and is much sought after for trousers, leggings, bags, purses and the like. The embroidery of shoes is a somewhat extensive business in the Punjab. Saddlery is hardly to be reckoned among the leather trades, and saddles are mostly padded and not made of leather; only the accessories are leather.

Miscellaneous Manufactures.

There are various small miscellaneous manufactures which deserve a word or two of notice. The trade of the *kamángar* and *tírgar*, maker of bows and arrows, is now almost extinct; but these people still practice part of their art in decorating wood surfaces with paint, gilding and varnish. The *papier mâché* and wood-work, covered with delicate painted ornament and varnished with copal, which is usually a prominent feature in Punjab exhibitions, is entirely confined to Kashmir. Why, it is difficult to say: it could be made anywhere. Ivory-carving is practised at Amritsar, chiefly in the production of small net-work or fretted designs pierced through. At Delhi figures are cut; but the work is unimportant. At Bhera in Shahpur stone-cutting for knife-handles, &c., is practised, and an occasional piece of stone inlay may be seen; this work could no doubt be developed if there were a demand.

Paper-making.

Paper-making is carried on at Siálkot, but is only suited to native writing in ink that does not penetrate beyond the glazed surface of the paper. Considering how many plants are available for paper fibre, and how great the demand for paper of a kind which can be used by the printers and for writing in the European style, it is remarkable that no attempt has yet been made to set up a paper mill: it is quite impossible, with the native process, to produce paper suitable for printing or European writing. The finer papers of Kashmir, however suited for Oriental manuscript and illumination, are, relatively, very costly.

General Remarks.

It will perhaps have been remarked that in the foregoing paragraphs allusion has repeatedly been made to the European demand for articles, and to an export trade. There is no concealing the fact, and especially in the case of ornamental, or what may be called "Art-manufactures," it is foreign taste that has led to the increased demand for certain classes of goods; and if only the demand can be extended to other Provinces and to other countries, there is no reason why it should be looked on with any disfavour. It is inevitable that it should be so, when the manufacturing specialities of the Province continue what they are. The wealthier natives may in time come to share the same tastes, and then the demand will be local as well. But at present most of the wealthier natives delight in having European articles in their houses, and

General Remarks.

those often of the gaudiest and least desirable description. The poorer classes, on the other hand, use so little furniture of any kind that carpets, curtains, furniture, and even the simpler cottage ornaments, are yet unknown to, and unthought of by, them. The real future of profitable manufactures that will sell among the masses is not in shawls, carpets, embroidery, wood-carving, lacquer and the articles that at present fill up a catalogue of Punjab and Kashmir handicrafts ; but in the hope to be able to produce locally fabrics that will undersell foreign cheap cloths, chintzes and prints that now flood the country, and in the supplanting of imported cheap paper, looking-glasses, needles, pins, cutlery, lucifer-matches, and a host of small wares which are in universal demand, by similar articles made in the country.

CHAPTER VI.

EDUCATION.

SECTION A.—SYSTEM OF PUBLIC INSTRUCTION.

Chapter VI, A.

System of Public Instruction.

Establishment of the Education Department.

The Department of Public Instruction in the Punjab was instituted in January, 1856, and the first Annual Report of the Director, the late Mr. W. Arnold, was submitted shortly after the outbreak of the Mutiny in the year following. Education, however, had occupied the attention of Government ever since the annexation, and at the time when the Department was organized there were 34 schools maintained from public funds, and 12 Mission Schools, most of which were in receipt of grants-in-aid.

Early Statistics of Indigenous Education.

Mr. Arnold's first step was to ascertain what the people had been doing themselves in the way of education. The idea of education was not new in the Punjab. A school phraseology was supplied chiefly by the Muhammadans, who as educators were in possession of the field. Not only was the Korán taught in every mosque, but outside a great many mosques the standard Persian works were taught to all comers. These Persian schools were the most genuine educational institutions in the country, and formed the foundation of the existing Government vernacular school system. The teachers were almost exclusively Muhammadans, but among the scholars the Hindús were more numerous than the Muhammadans. Schools in which only the Korán was read by rote, and those in which the children of shopkeepers were taught arithmetic and book-keeping, were left out of consideration as educationally worthless, and little more account was made of purely Arabic and Sanskrit schools, in which young men and boys were trained for religious functions. The statistics of Gúrmúkhi schools, which were chiefly of a religious character, were too imperfect to be of much assistance. Real Hindi schools were very rare, and most of those returned as Hindi schools were chiefly of the class described above for the benefit of shopkeepers or Brahmans. The average income of the teachers was found hardly to exceed Rs. 2 a month in cash, but offerings in kind and fees for performing religious ceremonies formed a material addition to their means of subsistence.

Organization of Public Instruction.

The Educational Department was administered at first by a Director, 2 Inspectors of Schools, 10 Deputy Inspectors, and 60 Sub-Deputy Inspectors. The schools directly supported by Government consisted of 24 Zillah schools, 100 Táhsíl schools, and 4 Normal schools. A cess of one per cent. on the land revenue was devoted to the maintenance of a large number of village schools. It was proposed to establish a Central College at Lahore, but this part of the scheme was necessarily postponed till there should be advanced students to profit by it. The Department so constituted cost about three lakhs of rupees per annum.

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Prejudices of the People against the Government System.

The first impression of the people, when they heard of a Government education scheme, was that their children were to be taught in exactly the same way as formerly by the Mián or Pandit, but that the teachers were in future to be paid by the Government instead of by the parents; and so long as this notion prevailed, Government education was extremely popular. Both teachers and scholars, however, particularly objected to the study of Urdu. To educate a boy by teaching him his own language seemed to them to be almost a contradiction of terms. It was of course necessary to conciliate the people, and the plan adopted was to give the teachers two lists of books—one of Urdu books which *must* be read, and another of Persian books which *might* be read.

Choice of the Urdu Language in the Persian Character.

It was resolved from the first to make the Urdu language and the Persian alphabet the one language and the one alphabet in Government schools, the Urdu language being chosen as more than any other dialect the common vernacular of the Province and the Persian character inasmuch as it was said to be used almost exclusively by the population of the western half of the Punjab, and in nearly two-thirds of the indigenous schools of the eastern districts. Besides which, the Urdu language written in the Persian character was used in the Courts, and was the most general medium of communication in the business transactions of all classes, except in matters pertaining to their particular trades and occupations. At the same time Hindi schools were to be encouraged wherever the people desired them, in view of the danger of throwing education entirely into the hands of the Muhammadans.

Question of the application of the Educational Cess and of opening Female Schools.

It was a question whether the one per cent. cess should be spent in aiding existing village schools, or in maintaining schools entirely under the control of the Department, each of which might serve for a cluster of villages; but when it appeared that the people held the payment of the cess as an acquittance of all claims upon them for the education of their children, the latter system was chosen by preference. It was intended at first that the establishment of schools for girls should be deferred until the new Department was in working order; but much interest was excited by the accounts received from the North-Western Provinces of the progress of female education, and in the first year several schools were opened in the Punjab, and were believed to be in a satisfactory condition, although the visits of European officers were not allowed.

Important change in 1860 in the System.

Such was the origin of public instruction in the Punjab, and its subsequent history has followed the lines then traced out. In 1860, however, an important change was made in the system of administration. It had been a moot point whether the management of the cess schools should rest with the Educational or District Officers, but during the first few years the practice of the North-Western Provinces was followed, by which schools of all kinds were under the direct control of the Department. The practical severance of the District authorities from the work of education obviously entailed a serious loss of power, and so much dissatisfaction was caused that the Vernacular schools, which formed the great majority, were transferred to the charge of the Deputy Commissioners. At the

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Important change in 1860 in the System.

same time the Native Deputy Inspectors were dismissed, or employed on reduced salaries as School Muharrirs, and an attempt was made to entrust the subordinate control and inspection of Vernacular schools to the Tahsíldárs. The necessity for professional superintendence, however, soon became apparent, and, eventually, each district had its District Inspector or Chief School Muharrir, who was subordinate to the Deputy Commissioner, and whose business it was to visit and inspect every school in his charge once a quarter, to maintain discipline, to appoint, transfer or promote teachers, and generally to be the Deputy Commissioner's principal executive agent in the management of the schools.

Progress of Education from 1860 to 1870.

In 1862 an enthusiastic movement was initiated in favour of female education, and a grand Darbár was held at Lahore under the presidency of Sir Robert Montgomery, then Lieutenant-Governor, for the purpose of enlisting the co-operation of the Chiefs and other native gentlemen of the Punjab. Under this impulse hundreds of schools were opened, and in 1866 the number amounted to about 1,000 with 20,000 scholars. But it was easier to create a nominal attendance than to obtain any substantial results, and before long, in consequence of necessary reforms, there was a very considerable reduction. There is no reason to doubt the wisdom of the change of system which led to diminished numbers, but it is to be regretted that there was so little foundation for an enterprise which at one time seemed to promise well. In 1864 Government Colleges were established at Lahore and Delhi. At the latter place there had been one before the Mutiny, which had since been in abeyance. In 1865 the *Anjuman-i-Punjab* was founded, and in connection with it a scheme was originated for establishing an Oriental University. The proposed institution has since developed into the Punjab University. Between 1868 and 1870 a change of considerable importance was made in the *status* of village schoolmasters. In 1859 their pay had been fixed in grades of Rs. 5, 7, and 10 *per mensem*, and although these grades had not been rigidly observed, they represented the average scale of pay up to 1868. It was now determined that no teacher, excepting assistants, should draw less than Rs. 10 *per mensem*, and as the time was unfavourable to proposals for increased expenditure, the result was that some300 schools were closed and 10,000 scholars struck off the rolls.

Effect of the Decentralization Scheme of 1871.

The financial change known as the decentralization scheme, by which the local Governments were entrusted with the duty of budgetting and controlling expenditure in certain departments hitherto treated as Imperial, was followed and supplemented by the Punjab Local Rates Act of 1871. The general effect of this Act in the course of the next few years was to double the amount hitherto received from the Educational Cess, which now became merged in the District Fund, and thus to increase largely the means at the disposal of the new District Committees for the education of the agricultural class. Meanwhile increased assignments were made by municipalities, and in 1873-74 the numbers on the rolls of village schools exceeded by 20,000 the lowest figure reached in 1869-70 after the reduction described above. At the same time, by raising the pay and position of teachers and of inspecting officers in the

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Further Development of the Educational System of the Punjab.

subordinate grades, a further step was made towards the improvement of the general efficiency of the schools.

The Education Report for 1875-76 shows that the number of schools and scholars, and the expenditure upon education, continued to increase, though not so rapidly as in the first year or two after the impulse given by the additional funds provided under the Local Rates Act. There was an apparent decrease in Aided Schools, which is explained by the transfer of certain aided schools under the management of Government officers to the category of Government schools. In fact, the grant-in-aid system, so far as native education is concerned, has in the Punjab been used almost exclusively by the Missionaries, whose valuable contribution to the education of the Province in no way represents the self-help of the people. In the same report the Director speaks "of the eagerness for education" displayed in some of the more advanced districts of the Punjab. This eagerness appears to have been due to certain orders of Government by which official appointments and promotion were to be reserved for those who had passed the Middle School Examination. But the examination proved to be too difficult or too technical for those who had not passed through the departmental course of studies, and, otherwise, it was not in the nature of things that the sanguine expectations of the student class should be realized. There was, accordingly, reaction before long, though on the whole progress has been maintained.

Brief Notice of Important Measures subsequent to 1871.

The Middle School Examination for all schools throughout the Province had been instituted in 1869, and in 1872-73 the first general examinations by the Upper and Lower Primary standards were held by the Inspectors. The classification of schools according to stages of instruction was gradually introduced during the following years, and in 1879-80 a revised set of statistical forms was adopted under the orders of the Government of India. Under the new system a school, which had hitherto been called a High School, with its high, middle and lower departments, was now treated in the returns as three separate schools—a High School, a Middle School, and a Primary School. Middle Schools in the same way were divided into two schools, and thus upwards of 100 schools were nominally added to the list. The creation of the Punjab University will be described in a separate paragraph. In 1877 the Government College at Delhi was abolished, or rather amalgamated with the College at Lahore. In 1875 the Mayo School of Industrial Art was established at Lahore, and in 1881 the Central Training College for the instruction of teachers employed in English schools and in Secondary Vernacular schools.

Progress of Education from 1871 to 1883.

The periodical disorganization of society by epidemic fever is familiar to those who have lived in Northern India. Between 1877 and 1880 education was seriously checked by this cause, and also by an extraordinary demand for labour during the Afghán War. The numbers nominally on the rolls were also reduced by the omission in the returns of some 2,000 scholars in jail schools, which were excluded from the revised statistical forms now brought into use. In his introduction to the Report for 1880-81, the Director made a statement of progress during the past ten

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Progress of Education from 1871 to 1883.

years. There is evidence of a sufficient improvement in the standard of attainments, but on the whole there is little reason for congratulation on the extension of education under the direct influence of the Department, notwithstanding a considerable increase in expenditure. Several measures of importance are now under consideration, but their history belongs to the future, and their general character only can be indicated here.* In connection with the extension of Local Self-Government, educational finance will be almost completely localized, the Education Department will be relieved of the management of the District schools, and the Middle School Examination will be held under the control of the University. A system of grants-in-aid by payments according to results has been carefully considered by the Director of Public Instruction and the Punjab University. The report of the Education Commission on this subject is now being awaited. In the case of indigenous schools, it will probably be necessary that the grant-in-aid should often take the form of allowances to competent teachers, and of lending trained teachers to these schools, either permanently or while the untrained teachers are undergoing a course of instruction in some Normal school. The proposed grant-in-aid scheme includes not only certain payments for passes in each subject by four standards, *viz.*, the Entrance Examination, the Middle School Examination, the Upper and Lower Primary School Examinations, but also salary grants to teachers who hold certificates, or have passed equivalent examinations. The kindred question of the grant of scholarships has also been under consideration. The proposed scheme, which has been accepted by the Syndicate, provides a graduated scale of rewards of merit from the Upper Primary Examination to that for the degree of Bachelor of Arts and of Oriental Learning. The Director, in concert with a Text-book Committee and with the assistance of his own staff, has brought out a considerable number of improved school-books; but much remains to be done in this department. A renewed effort will be made for the extension of primary education by encouraging the most promising of the indigenous schools, of which a very complete census has recently been taken for the first time.

The progress of female education has not been satisfactory. Some good schools for girls have sprung up under the management of ladies familiar with the European idea of education, and arrangements have been made for the employment of English ladies in the inspection of schools which are closed to officers of the Department.

History of the Punjab University.

A detailed history of the Punjab University will be found in the succeeding section of this Chapter. The proposal to establish a University at Lahore was recommended by the Punjab Government in 1868. The Governor-General in Council was at that time unable to sanction the scheme. He was willing, however, to allow a grant-in-aid equivalent to the annual income of Rs. 21,000 expected from private sources on condition that, instead of expending the funds in establishing a University or examining body, they

* These measures have since been carried into effect on the lines indicated above.

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should be applied to the extension and improvement of the existing Lahore Government College on the principles advocated by the Punjab Government. The decision of the Government of India failed to satisfy the promoters of the Punjab University, and after further correspondence a compromise was accepted by them as a step towards the fulfilment of their design. The new institution, which was styled "The Punjab University College," was inaugurated by Sir Donald McLeod, as President, in January, 1870. A governing body called the "Senate" was appointed, and statutes were framed in which the special objects of the University College were declared to be--(1) to promote the diffusion of European science, as far as possible, through the medium of the vernacular languages of the Punjab, and the improvement and extension of vernacular literature generally; (2) to afford encouragement to the enlightened study of Eastern classical languages and literature; (3) to associate the learned and influential classes with Government in the promotion and supervision of popular education. To carry out this policy the University College established an Oriental School and College at Lahore; endowed lectureships, literary fellowships, and scholarships; and held public examinations in the various subjects of study which it was desired to encourage.

The desire of the Punjab people for a University of their own never abated however. The question was revived in 1878 in connection with a movement made on the occasion of the Imperial Assemblage at Delhi on 1st January, 1877, and the Secretary of State, on being satisfied that the examinations of the Punjab University College were of such a nature as to justify that body being entrusted with the power to grant degrees, accorded his permission to the introduction of an Act for the incorporation of a University in 1880. An Act for this purpose was accordingly passed in 1882 as Act XIX of that year, and on 14th October the Punjab University was incorporated and received the power of conferring degrees for Oriental Learning and Arts. The Viceroy consented to become the patron of the institution, the Lieutenant-Governor was appointed *ex officio* Chancellor, and the members of Senate were designated Fellows. Authority is granted by the Act to the Governor-General in Council to empower the University to confer degrees in law, medicine, science, and engineering also, when it shall be proved to his satisfaction that the arrangements and examinations of the University are such as to render the conferring of these powers desirable.

Organization of Schools for General Education.

Schools for general education, whether departmental or aided, are classified as Vernacular or English, and as Primary or Secondary. Primary Schools afford a course of instruction extending over five years and terminating with an examination called the Upper Primary Examination. There are five classes, of which the first three form the Lower Primary School, and the fourth and fifth the Upper Primary School.

In the Lower Primary Division of English as well as Vernacular Schools there is a uniform course of study, which includes vernacular reading and writing, arithmetic as far as the compound rules, a little Persian, and the maps of the Punjab and India. In

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the fourth and fifth classes English is studied in English Schools and mensuration in Vernacular Schools. The other subjects of study are similar in both kinds of schools. For the Upper Primary School Examination a scholar has to read at sight and write from dictation passages from a newspaper or book of ordinary difficulty, to work sums in fractions, rule of three, and interest, and to show a fair elementary knowledge of Persian and of general geography. In Girls' Schools less arithmetic is required than from boys, and some special text-books have been prescribed, but the classification and standards are very similar.

The Secondary Schools consist of Middle and High Schools. A Middle School contains three classes and a High School two classes, each class representing a year's study. All who are admitted to the Middle School have passed the Upper Primary School Examination, or some equivalent test, and in the same manner the Middle School Examination is the test of admission to a High School. The Upper and Lower Primary and Middle School Examinations are compulsory for all schools. The subjects of study in Middle Schools constitute a course of preparation for the Middle School Examination. In this examination candidates from English Schools have to translate from English into Urdu and from Urdu into English. There is also a paper on grammar, and marks are given for caligraphy. Candidates from Vernacular Schools are examined in four books of Euclid, and in Algebra as far as simple equations. All are examined in Persian, Urdu, arithmetic, mensuration, geography and history. There are also optional subjects which may be taken up, *viz.*, Arabic, Sanskrit, and Physics. The examination is conducted through the medium of Urdu, the recognized vernacular of the Punjab. Scholarships to a limited extent are awarded in order of merit, and are tenable in English and Vernacular High Schools. The course of instruction in High Schools leads up to the Entrance Examination of the Punjab University either in English or Vernacular, and is a continuation of the studies prescribed for Middle Schools, but carried to a higher stage. The same parallel division of studies is maintained in the University. The Government College at Lahore and the Mission College at Delhi admit students who have passed the Entrance Examination in English. The course of instruction in the Oriental College, Lahore, is intended for those who are unacquainted with English, but the subjects of study are considered of equal difficulty. The Middle School Examination has hitherto been conducted under the control of the Director of Public Instruction, but arrangements are in progress for transferring the management to the Punjab University.

Statistics of Schools and Scholars.

The Educational Institutions of the Punjab recognized by Government for the year 1882-83 are comprised in the following list: The Government College at Lahore; the Aided College of the Cambridge Mission at Delhi; the Oriental College and School of the Punjab University; 25 High Schools or departments of schools; 206 Middle Schools or departments of schools; 1,559 Primary Schools, including the lower department of Secondary Schools; a Training College and 4 Normal Schools for teachers;

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Statistics of Schools and Scholars.

a Medical School, a School of Art, 3 Industrial Schools. All the above are for males; but there were besides these 1 High School, 4 Middle Schools, 321 Primary Schools, and an Industrial School for females. Of institutions for the education of males the Arts' Colleges contained at the close of the year 113 scholars, High Schools 674, Middle Schools 6,088, Primary Schools 98,696, Special Institutions 539. These numbers are exclusive of the students of the Oriental College and of the Lawrence Asylum at Sanáwar. In female schools there were 9,826 pupils, besides 134 in Special Institutions. The total number of institutions was 2,133 and of scholars 116,070.

Indigenous Schools.

By the desire of His Honor the Lieutenant-Governor an enquiry was made during the cold weather of 1882-83 into the condition of the Indigenous Schools of the Province, and full information was obtained as to the number of these schools, their locality, their teachers, the subjects of instruction, and other matters. The result of the enquiry shows that there were 13,109 schools of all kinds, with 135,884 scholars on the rolls. Of the scholars 25,576 were Hindús, 103,133 Muhammadans, 6,616 Sikhs, and 59 others. By occupation 74,429 were agriculturists, 60,955 were artizans, and others non-agriculturists.

The schools may be classed according to subjects of instruction as follows :—

Persian schools ...	... 458	with	4,015	scholars.
Persian and Korán schools	... 2,767	,,	34,985	,,
Purely Korán schools ...	... 7,170	,,	60,951	,,
Arabic schools ...	... 347	,,	4,027	,,
Gúrmúkhi schools ...	... 1,097	,,	13,021	,,
Hindi (Nágri) schools ...	... 82	,,	1,287	,,
Sanskrit schools ...	... 493	,,	5,081	,,
Lande or Máhájani schools	... 492	,,	8,629	,,
Miscellaneous schools ...	... 203	,,	3,388	,,
Total schools	... 13,109	with	135,384	scholars.

In only 3,357 schools were there more than 12 scholars on the rolls, and 5,416 schools had each less than six scholars.

The qualifications and disqualifications of the teachers are as follows: 5,216 cannot read a printed book, 5,782 cannot write, 9,595 are unacquainted with Elementary Arithmetic.

The great majority of the scholars read religious books, which they are not taught to understand. The proportion of schools is greatest in the west, and especially in the Ráwalpindi Circle, where there is a large preponderance of Muhammadans, whose practice it is to read the Korán, and of Hindús or Sikhs who read the Granth in the same way. The statistics were collected by the District Inspector, and, as far as possible, by personal enquiries on the spot. In some cases the people were suspicious and unwilling to give information. In others, from a desire to obtain grants-in-aid, the numbers were exaggerated. But on the whole there is no reason to question the accuracy of the results, which are more complete than any which have hitherto been elicited. It is proposed to aid the Indigenous Schools by grants on a system of payment by results, and by small monthly allowances. The ignorance of the teachers makes it difficult to organize any system of improving these schools, and

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in most cases nothing is taught or desired in the way of general education. But the art of reading by rote from a printed book may easily be applied in a more useful manner, and some germs of a system of elementary education may be recognized in the humblest of these schools. The statistics of indigenous girls' schools were not included in this enquiry, but it is not unusual for young girls to receive religious instruction in some parts of the Province, and in one district, Hazára, upwards of 2,000 were reported to be at school.

SECTION B.—THE PUNJAB UNIVERSITY.

Preliminary.

The Punjab University was called into existence on the 14th October, 1882, by a notification issued by His Honor the Lieutenant-Governor of the Punjab in pursuance of the provisions of the Act of Incorporation, XIX of 1882, which received the assent of His Excellency the Governor-General in Council on the 5th of the same month. The Act of Incorporation was, however, only the final act of recognition given to an institution which, under the name of the Punjab University College, had been exercising all the powers, other than those of conferring academical degrees, of an University since the beginning of 1870 under the sanction of the Government of India and of the Secretary of State for India. The Punjab University College itself, though recognized and supported by Government, had been originated and established by the pecuniary and other aid of the Chiefs, nobles, and influential classes of the Province, through the agency of a society called the Anjuman-i-Punjab. It was essentially an unofficial institution, while it received the assistance of Government under the grant-in-aid system.

The movement for a University, 1865—1869.

The Anjuman-i-Punjab Society was formed in January, 1865, with the two-fold object of reviving the study of ancient Oriental learning, and of diffusing useful knowledge through the medium of the vernacular.

While the advantages of an English education were fully recognized on all hands, it was felt that the system of State education altogether ignored the historical, traditional, and religious aspects of the educational question in India. It attempted to impose the European system without sufficient modification to bring it into harmony with national feeling and the requirements of the country; and it had been so rigidly enforced on a standard pattern throughout the country that indigenous educational institutions had well nigh perished. English, as a language and as a medium for education, had already acquired the support of a strong official organization; the Anjuman-i Punjab in no way objected to this, but pleaded the cause of those important features of the educational requirements of the country which had, it thought, been neglected or forgotten.

Sir Donald McLeod, at that time Lieutenant-Governor, extended his hearty sympathy to the movement which had thus been originated, and the deliberations of the two hundred members who had by this time joined the Society resulted in the conclusion that

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the best and surest remedy for the defects of the existing system, and for combining in one the efforts of the Government and of the people in educational matters, was the establishment of an Oriental University. This institution was to support the existing educational work, but was to add to it the proper encouragement of the study of the Oriental classical languages, and the general diffusion of useful knowledge in the "vulgar tongue." The classical languages of India were the sources not only of the languages spoken at the present day, but also of the traditions, religions and ancient history of the Indian nation. No system which ignored Arabic or Sanskrit could hope to meet with respect, popularity, or support from the people of India; while any errors in scientific teaching, which the ancient literature might contain, could easily be eliminated or corrected by the light of modern European knowledge. The idea of an Oriental University for Northern India or for the Punjab was enthusiastically received. A European Committee of support was formed, and a scheme drawn up in some detail.

The nature of the demands of the promoters of the movement for an University may be gathered from the outlines of the proposals published in 1865. In this the promoters asked for an Oriental University. The word *Oriental* was not used to represent that the English language and Western science were not to be encouraged and supported; but that the University was to bear the impress of an Oriental nation; that the Oriental classics and vernacular languages of the country were to be encouraged and developed; that the masses of the people should have the boon of the civilizing influences of education extended to them in their own language; and that the institution should not be a mere body for holding examinations in the European curriculum only, but should also teach and examine in the languages used by and dear to the people. Sir Donald McLeod had himself advocated the revival of ancient learning and the perfection of the vernaculars of the country, not at the expense of an English education, but side by side with it, and supplying the deficiencies of the latter. This line was accepted by the promoters.

The proposals having been revised and matured by the Society and the European Committee, Messrs. Brandreth and Aitchison were deputed to lay them before His Honor the Lieutenant-Governor. This was done on the 13th October, 1865, and His Honor promised his support to the movement, but intimated that the portions of the scheme which related to academic degrees required the sanction of the Government of India. In February, 1866, the leading gentlemen of Lahore and Amritsar presented an address to Sir Donald McLeod, whose reply expressed great satisfaction at the development of a movement in which the people of the Province had displayed so much interest; the views of the Government were given at considerable length, and in conclusion His Honor assured those who had taken part in the address that, "for the encouragement of educational efforts so entirely in accordance with the educational despatch of 1854," Government aid, to such extent as might be deemed advisable, would not be refused.

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The Society continued to advocate its views with wavering success but unswerving persistency until 1867, when their action aroused the rivalry of the British Indian Association in the North-Western Provinces. In August of that year the Association petitioned the Viceroy, pointing out objections to the educational system, and recommending the establishment in the North-Western Provinces of a University in which the Eastern classics and the vernaculars would be duly encouraged side by side with English education. This rivalry was the fortunate cause of again drawing public attention to the popular feeling on the subject of education, and established the fact that the agitation which had arisen was a genuine one. In replying to the Association the Government of India expressed itself ready and willing to support the principles laid down in the despatch of 1854, and to encourage the study of Western science, through the medium of the vernacular; but while promising every assistance to societies or individuals like those in the Punjab and North-West, it was unable to establish at once a University. Money, assistance, careful consideration and official recognition were promised, but not the immediate incorporation of a University.

His Honor the Lieutenant-Governor of the Punjab at this time expressed an opinion that owing to the difficulty of forming a proper governing body, in the Upper Provinces, for a University, it would perhaps be better to induce the Calcutta University to modify or enlarge its existing rules. The Senate of the Calcutta University, however, declined to modify their schemes, and recommended a separate University for Upper India. On the 12th of March, 1868, a general meeting of those interested in the promotion of the University scheme was held under the presidency of Sir Donald McLeod, and resolutions were passed in favor of a University, specially for the Punjab, to be situated at Lahore. The people of Delhi had, in the meantime, taken measures to advocate the claims of that time-honored capital as the seat of the proposed University; but when the agitation arose in the North-Western Provinces, they agreed to sink all differences rather than lose the chance of a University for the Punjab. The principles already set forth were reiterated, and the Punjab Government accepted these proposals, and caused a letter to be drafted to the Government of India in terms of these resolutions. It contained a complete scheme for the constitution of the proposed University, and a request for a sufficient grant-in-aid. The movement had received the support of the Chiefs, nobles and influential classes of the Punjab, and already a sum of Rs. 1,00,000 had been raised from private sources, while much more was expected. But the reply received from the Government of India was unfavorable to the immediate incorporation of a University.

This decision caused great disappointment in the Punjab, but was not received as a final settlement of the question. Sir Donald McLeod replied, thanking the Government of India for the concessions made, but he feared that these concessions would not be of much practical value unless the scheme submitted were also sanctioned, and that the withholding of this sanction was likely to discourage and bring to an end the educational movement which had sprung

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up amongst the leading members of the aristocracy and gentry of the Punjab. In subsequent correspondence the Punjab Government met all the objections which had been raised, and expressed their own willingness and that of the promoters of the movement for a University to accept, in the first instance, a status lower than that of a full University until the Government of India were satisfied that the complete powers of a University might, with credit and safety, be entrusted to the governing body which should be created.

Sanction to the Punjab University College.

On the 23rd of May, 1869, the Government of India wrote as follows :—

"The Governor-General in Council was fully sensible of the value of the spontaneous efforts which had been made by the community of the Punjab, both native and European, for the establishment of a local institution which should have for its object the development of learning, especially in connection with the vernacular languages.

"His Excellency was glad to find that the chief objections which had until then prevented him from giving a cordial sanction to the measure had been removed. The principal of these had been that if the proposed institution were at once established as a University, it would probably, at first, confer a lower class of degrees than those given by other Universities in India, and this would tend to degrade the character and lessen the value of an Indian University degree.

"It was, however, understood that the Punjab Government was willing that the proposed institution should not at once assume the full character of a University; but that until the number of students and the power of teaching in any branch of study, or in any faculty, could be shown to be sufficient to warrant the conferring of a University degree, it should not have the power of granting degrees, but of certificates only.

"It was also understood that the study of English would not only form one of the most prominent features of the teaching in all the schools or colleges connected with the institution, but that both teaching and examination in subjects which cannot with advantage be carried on in the vernacular would be conducted in English.

"It was accepted as a principle that the examinations should be entrusted to other persons than those who were engaged in teaching the students; and the Lieutenant-Governor had expressed his willingness to accept any rules which should be laid down with a view to secure this object.

"Lastly, it was understood that, although certain subjects should be taught in the vernacular, the teaching in mental and physical science would be free from the patent errors which prevail in ancient and even in modern vernacular literary and scientific works."

On these conditions the establishment of the proposed institution was sanctioned. The governing body was to have power to teach, confer fellowships and scholarships, and certificates of proficiency. It was to be, with the educational officers of Government, the consulting body in all matters of public instruction, including primary education.

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Meanwhile the papers went to the Secretary of State for India, who accepted the conclusions of the Government of India, remarking that—

"The institution will be competent to grant certificates but not degrees, and may, hereafter, if attended with due success, be expanded into a University."

The Government of India, in forwarding the final authority, required—

"That the institution should be called by some such title as *University College* which would mark the fact that the present arrangement was only temporary, and was intended only as preliminary to the possible establishment, at some future time, of a University in the Punjab."

A grant-in-aid of Rs. 21,000 was conferred, subject to the rules in that behalf.

Under this incomplete constitution the Punjab University College entered upon its existence. The arrangement effected resulted in the Schools and Colleges having either to prepare candidates for two separate systems of examinations, *viz.*, those of the Calcutta University, and those of the new institution—the tests being altogether different in their character, though of equivalent standards—or else to disregard the Punjab University College tests altogether. By liberal scholarships and considerable efforts the latter catastrophe was avoided; but the difficulty of the dual system of studies caused considerable inconvenience to both pupils and teachers throughout the Province. The candidates were anxious to obtain the proper academic distinctions which the Calcutta University could alone confer; while the Punjab University College desired to assert its own position as the proper source of academic distinction in this Province.

The Punjab University College from 1870 to 1876.

The history of this institution divides itself into two nearly equal periods, one extending from January, 1870, to December, 1876, and the other from the last-named date to the passing of the Act of Incorporation of the Punjab University on the 5th of October, 1882. The first six years were devoted to the growth and development of the Punjab University College, and the work done during this period was of so substantial a character that at the time of the Imperial Assemblage the Viceroy and Governor-General, Lord Lytton, pledged himself "to introduce a Bill, as soon as possible, into the Legislative Council for the purpose of giving to this institution the status of a University with the power of conferring degrees." He promised that this pledge would be fulfilled as soon as the necessary formalities could be completed. Up to this time the Government of India had more than once refused to convert the University College into a full University; but in six years the institution had acquired strength and completeness, and had been attended with such a "measure of success" that the Government of India had promised to accede to the request at once.

Between 1870 and the end of 1876 the Endowment Fund rose from Rs. 1,05,660 to Rs. 3,55,300. The annual income reached Rs. 45,000, the whole of which was expended. The Senate Hall building, commenced in 1874, was completed and brought into use at a cost

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The Punjab University College from 1870 to 1876.

of Rs. 35,283, of which sum His Highness the Nawab of Baháwalpur munificently contributed Rs. 27,331. The founders of the University were made its first governing body by the name of the Senate ; the first meeting was held on the 11th of January, 1870 ; the first six months were devoted to organization and to the making of rules and regulations for the conduct of business and examinations ; an Executive Committee was appointed and faculties were organized ; and regular work commenced about July.

The Calcutta University held the control of the Schools and Colleges which taught in English, and it was not possible for a body with the defective constitution of the University College to replace it at once. Its first and great object was therefore to encourage and develop those phases of educational work which had hitherto been neglected, namely, the revival of the study of Sanskrit and Arabic, and the diffusion of knowledge through the medium of the vernacular. The first examinations were accordingly held in Arabic, Sanskrit and Persian in July, 1870 ; and sixty-seven candidates presented themselves, of whom forty-three passed successfully as Maulvis, Pandits, or Munshis, respectively.

In 1871 an Entrance and First Arts Examination were added to the examinations held. The Medical School Examinations were taken over, and were conducted under the auspices of the University; diplomas as Licentiates being conferred upon those who passed at the Final Examination. In 1873 the Arts schemes were revised by a Committee, which represented both the University College and the Department of Public Instruction ; and in 1874 the Entrance, Proficiency and High Proficiency Examinations were held in addition to the Oriental series in Sanskrit, Arabic, Persian, general knowledge, and native medicine. Arrangements were made in this year for examinations in the faculties of Law and Engineering, which were held in 1874 and 1875, respectively, for the first time. Up to 1876 about 1,800 candidates appeared at the various examinations, of whom over 1,000 passed.

The first calendar was brought out in 1874. In that year the University College had completed the work of its own organization, rules and regulations having been framed in every department. The years 1875 and 1876 were, therefore, the first years of full work. Between 1870 and 1876 great advances had been made in the work of translation of books required in the curricula of the Schools and Colleges, and the vernacular department had made great strides.

Oriental College.

In order to teach the Oriental languages upon modern principles, and to impart a knowledge of modern sciences through the medium of the vernacular, an Oriental School was opened in August, 1870. This school had been originally founded, in 1865, by the Anjuman-i-Punjab, and it had then been the object of large donations from Native Chiefs. When, for certain reasons, the Oriental School was closed, the subscriptions and donations ceased. After its reopening, under improved auspices, very liberal subscriptions and donations again poured in. And when some of the students matriculated and passed higher examinations on the Oriental side, a college depart-

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Oriental College.

ment was added, and the name Oriental College was given to this, the chief teaching institution of the University College. Its position in 1877 is thus described in the reports :—

"To recapitulate briefly, the objects of the College are two-fold : (1), to give a high classical Oriental education, together with instruction, in branches of general knowledge ; and (2), to give a practical direction to every study. Men who intend to devote themselves entirely to Literature or Science have scholarships and fellowships to look forward to with their incumbent duties of teaching and translating, or they may return to their homes as thoroughly trained Maulvis or Pandits who have also received a liberal education. Those who aspire to the dignity and function of Qazis are trained in their own law. Persons who wish to take up the practical work of teaching in Army Schools or in the Educational Department will, it has been promised, be admitted to a course in the Normal School."

Thus it was the object of the Oriental College to embody, as a teaching institution, those principles which the Punjab University College, in another capacity, enunciated in its examinations. It emphasized the Oriental as the Government College did the English side of the educational system.

The Law School.

The Law School was first established by the Anjuman-i-Punjab in 1868. Down to 1874 no University Examinations in Law were held, but the students were sent up to the Pleaders' Examinations held under the Legal Practitioners' Act and the rules framed thereunder by the Judges of the Chief Court. These examinations were, however, handed over to the University College in that year, thus recognizing and assuring the position of the Law School in the most practical and efficient manner possible.

From 1877 to 1882

A very brief record will suffice to give an account of this the last period of the existence of the Punjab University College. In December, 1876, the Senate presented a last memorial to the Viceroy, which resulted in the promise of a University, which was made public at the Imperial Assembly in January, 1877. Each year had seen the University College attain greater success and solidity ; and a few statistics will best explain what had been effected. The Endowment Fund did not increase with much rapidity owing, no doubt, to the "hope deferred" of past years, and the delay in fulfilling the pledges given. Rs. 3,84,495 stood in Government Securities to the credit of the new University in 1882. The Senate Hall building is now estimated at Rs. 40,000. The income rose to Rs. 75,000 and the expenditure expanded accordingly, as the following figures show :—

DETAILS.	1877.	1878.	1879.	1880.	1881.	1882.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Income ...	44,914	53,230	55,991	63,115	64,953	75,495
Expenditure...	53,014	56,495	57,573	59,598	63,881	70,419

The Government grant still stood at Rs. 21,000.

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The Punjab University.

From 1877 to 1882.

In the year 1879 the Punjab Government promised to reconsider the grant when the University was established. It is believed that this will now be done.

A large number of institutions were affiliated to the University College in the sense that they taught up to its standards and upon its principles, and received in return grants-in-aid or scholarships. The University Act emphasizes the liberal principles of the University by making no provision for affiliation in the sense in which that term is used in other Universities. The Punjab University throws open its examinations to all institutions alike, as well as to private students. It demands a definite course of reading and standards based upon its own principles. It also offers its aid and scholarships upon the results attained, and upon nothing else. In this sense all competent institutions are affiliated to it. Its teaching institutions, the Oriental College and Law School continued to develop and flourish from 1876 to 1882. Much was achieved in the direction of supplying a vernacular literature. The Fellowship-holders have translated many important works, especially those required for the various curricula of instruction, in medicine, natural science, mathematics, history, and other branches of knowledge. Indeed, in several branches, instruction and examination is now successfully carried on through the medium of vernacular up to the Master of Arts standard. In Law and Engineering also much progress was made in the translation of works of importance.

The examination work was from the first conducted by examiners appointed by the Senate, who have been altogether unconnected with the teaching of the candidates in the various subjects. Indeed, most of the examiners have been entirely unconnected with the University and the Province. This principle was prescribed by the original Statutes of 1869, and has had the effect of silencing criticism and of giving confidence in the genuineness of the work done. The lower examinations have been conducted at several centres besides Lahore; Delhi and Lucknow being the most important. The number of candidates during this period was 3,600; the number who passed was 1,911.

Apart from the purely Oriental Examinations, the vernacular candidates for the various Arts Examinations of the Punjab University from 1871 to 1882 (inclusive) numbered 652. The total number of candidates in the various Oriental Examinations from 1870 to 1882 (inclusive) was 2,351.

Final constitution.

On the 13th November, 1880, the pledges given had not been fulfilled, but the Secretary of State had in the meanwhile sanctioned the proposal of the Government of India, and the necessary legislation alone remained for consideration. Accordingly a very large and influential deputation of the Senate, headed by the Honorable Sir Robert Egerton and His Highness the Mahárája of Kashmir, G.C.S.I., waited upon the Viceroy, on the occasion of his visit to Lahore, and presented an address to the following effect, namely, they felt sure that the Marquis of Ripon would support the pledges given by Lord Lytton, and would repeat the promise to complete at once their great National Institution. They referred to Sir Robert Egerton's letters of the 7th July, 1877, and 12th July, 1879, for the

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arguments in favour of a Punjab University, written by His Honor soon after succeeding to the Government of this Province. They, however, more specially brought to the notice of His Excellency that 729 students had already passed the Entrance Examination of the College, and that as many as 60 under-graduates were now prosecuting their studies for higher honors in English, by the aid of scholarships from the University funds. They also pointed out that out of 1,747 students who had presented themselves for the various Examinations in Arts, 1,217 had come up for the English Examinations, and that the number of candidates for the Entrance Examination in English had increased from 26 in 1873 to 193 in the examination for 1880. They trusted that this would be a sufficient reply to any objections that might be raised that the Punjab University College did not sufficiently encourage the study of English.

Lord Ripon's reply was most favourable. A Bill was presently introduced into Council, and eventually passed as Act XIX of 1882; and on the 14th of October of that year a notification by the Punjab Government formally constituted the Punjab University. The inaugural convocation was held at Lahore on the 18th November, 1882, in the presence of the Viceroy, who is the patron of the University. The new constitution completely fulfilled the wishes of the donors, subscribers and promoters of the institution. An Oriental University has been combined with an English University; provision has been made for the due encouragement and development of the national classical and vernacular languages; the teaching, examining and literary functions of the Senate have been emphasized; and, lastly, the governing body is largely representative in its character, and possesses the right to represent its views to the Government and the privilege of being consulted by it. It is thus a National University in the truest sense. The Statutes of 1869 provided that the highest honors should only be conferred when proficiency in Arabic or Sanskrit or some other Oriental language was combined with a thorough acquaintance with English. The Act separates the two faculties and gives equal recognition and honor to each, and the Regulations provide for the acquisition by graduates of the combined honors of both as being naturally the highest distinction. Each faculty possesses an equal series of degrees, while the Oriental Faculty possesses special powers for honoring proficiency in Oriental languages by the conferring of Oriental literary titles and marks of honor. This separation, which still permits of interchange, leaves both sides free to develop side by side without conflict, and will afford a healthy emulation between the two systems. Both English and Vernacular are recognized and honored to the full extent, and both are open to the people of the country. The new degrees naturally took the names of Bachelor, Master and Doctor, respectively, of Oriental Learning.

The next point for consideration is the constitution of the governing body. His Excellency the Governor-General was unable for various reasons to accept the office of Chancellor, and it was decided to constitute the Lieutenant-Governor of the Punjab for the time being Chancellor of the University, and thus the head of the

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University is in a position himself to supervise its working, while the original proposal of the promoters has been carried out. The Vice-Chancellor is appointed by the Chancellor. The Act makes a distinction between the original founders and donors by providing that the Fellows named in Part II of the Schedule to the Act do not cease to be such when they quit India permanently; while those who may be appointed subsequently vacate office upon leaving India without the intention of returning or by remaining absent from India for more than four years. It was not deemed necessary or proper to make any distinctions amongst the Fellows themselves—all being equal. A great concession, from an Anglo-Indian standpoint, was made by the Legislature in leaving the Senate to elect a number of Fellows equal to the number nominated from time to time by the Chancellor. This provision gives a representative character to the Senate which cannot fail to be a source of good; the principle of Self-Government has thus been liberally conceded in this particular.

The powers of the Senate over the affairs of the University are very complete and full, and the necessary supervision has been effected in such a way as not to interfere with the Senate's exercising all the authority which is required for the purposes for which it has been founded. The Senate possess the "entire management of and superintendence over the affairs, concerns and property of the University." The Local Government is empowered to enforce the Act, Statutes, Rules and Regulations where the Senate may fail to do so. The Statutes, Rules and Regulations which may be framed require the sanction of Government; and the Local Government can require such examination and audit of the accounts of the University as may appear necessary. Internal autonomy is thus secured unless and until inefficiency or worse is displayed. In carrying out these principles the Senate have had to redraft their Statutes, and this has been done with scrupulous regard to the wishes of the promoters, and subject to the altered condition of things at the time.

In 1865 the promoters desired that the Government should give aid to the University by grants of money and lands. In 1869 a grant-in-aid of Rs. 21,000 a year was sanctioned. In 1879 the Local Government promised to reconsider the matter when the University should be incorporated. This will no doubt now be done; and it is to be hoped that grants of land may form a feature of the aid given.

SECTION C.—SCHOOLS AND COLLEGES.

Lahore Government College.

This College was founded in 1864. Its purpose is to afford the means of a University education to all in the Province who may desire this. Only such as have passed the Entrance or Matriculation Examination are admitted, and these are prepared for the University degrees in Arts. Previous to the establishment of the Punjab University College in 1870, only the courses of the Calcutta University, to which the College is affiliated, were followed. From 1870 till 1882, when what had been the Punjab University College

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became the Punjab University, with power to confer degrees, an attempt was made to meet both the Calcutta and the local standards; but now the course of instruction has been made to conform exclusively with the schemes of the new Punjab University. There are three distinct courses of study—the *Intermediate Course*, extending over two years from the date of matriculation, and embracing at least *four* and not more than *five* subjects; the *B. A. Course*, also of two years and embracing either *three* or *four* subjects; and the *M. A. Course* of one year in the entire field of one branch of literature or science. The subjects in which instruction is given are—(1) English, the language and literature; (2) Arabic, Sanskrit and Persian; (3) History and Political Economy; (4) Mathematics; (5) Mental and Moral Science; and (6) Physical Science.

The College building is situated in Anárkali on an elevated site to the north of the Public Gardens, and adjacent to the District Courts. It is an imposing structure, of Gothic style, with a large centre clock tower. Besides the Government College, the building accommodates the Central Training College and the classes of the Oriental College and School. These occupy the whole of the north-east wing, whilst the whole of the main front block is set apart for the Government College. This block contains a large hall, used for examining and convocation purposes, six large and three small class rooms, and a Professors' common room. The cost of the building was Rs. 3,20,605, which was met from Provincial funds.

The College is supported entirely by Government, and is under the control of the Department of Public Instruction. The staff consists of a principal, who is responsible for the management of the institution, and who is also Professor of English Literature and History; of three Professors, to whom the subjects of Mental and Moral Science and History, Mathematics and Physical Science are entrusted; of four Assistant Professors, and a Maulvi and Pandit.

From the figures given below, it will be seen that the average attendance in the College for the last five years has been 96, and the average annual cost Rs. 48,878 :—

Years.		Average attendance.	Average cost.
			Rs.
1878-79	...	88	47,781
1879-80	...	83	48.049
1880-81	...	100	54.183
1881-82	...	103	47,902
1882-83	...	106	46,476

The number of students on the roll in 1883 was 157, of whom 118 were reading the Intermediate Course, 33 for the B. A. and 6 for the M. A. degree. The following table gives the number of passes from the College by the University examinations for the last five years, showing an aggregate for the period of 63 by what is now the intermediate standard, 24 by the B. A., and 6 by the M. A.:—

Years.	First Arts & Proficiency.	B. A. & High Proficiency.	M. A. & Honors.
1879-80 ...	11	6	2
1880-81 ...	19	10	...
1881-82 ...	8	2	1
1882-83 ...	11	1	3
1883-84 ...	14	5	...

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Lahore Government College.

The College has attached to it a library containing 1,360 volumes. In connection with the teaching in Physical Science, there is a fairly well-stocked museum of apparatus, and a collection of minerals, rocks and fossils, presented by the Geological Department. There is a Debating Club connected with the College which meets every Saturday for the discussion of matters of scholastic and practical interest. For the convenience of the students, a Boarding House is attached to the College, and has now 69 in residence.

The Lahore Oriental College.

The origin of the Oriental College is as follows: A Hindi Sanskrit *Pathshálá* was established in 1863 at the premises of the Lahore *Shikoha Sabha* by private subscriptions of certain native gentlemen, which afterwards received a monthly grant-in-aid from the Government. This School was subsequently taken over by the Anjuman-i-Punjab, which added to it the Arabic and the Persian Departments. In 1870 the Senate of the Punjab University College took over the institution and expanded it into a College with a School Department attached to it. The teaching of *Pushtu, Gurmúkhi,* Civil Engineering, Physical Science, the native systems of medicine, and the Hindú and Muhammadan law was gradually introduced in the College.

From the time the Oriental School was taken over by the Punjab University College it has been entirely supported from the funds of the latter institution and of its successor, the Punjab University.

The Oriental College was first established in a *nazul* building called *Kharak Singh's Haveli*, situated between the Lahore and Mori Gate of the Lahore city. It was afterwards removed to a rented house in Anárkali, and on the completion of the Government College building it was located in its north-eastern wing, where it still continues. There are two boarding houses, one for Hindús and the other for Muhammadans, attached to the College. There are hired premises situated in the city.

The object of the Oriental College is to train up students for the Oriental Degree and Title Examinations of the Punjab University, for which purpose this is the only institution existing in the country, or, in other words, the revival of the ancient Oriental learning and the imparting of instruction in Western sciences and general knowledge through the standard vernaculars of the Province, *viz.*, Urdu, Hindi, and Punjabi. The education imparted in the Oriental College ranges from the High School Course to that for the Master of Oriental Learning Degree. The College also prepares students for the diploma and titles of Proficiency, High Proficiency and Honors in Sanskrit, Arabic, Persian and Gurmúkhi, as well as for

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the lower Civil Engineering, the native medical, and the Hindú and Muhammadan Law Examinations and for vernacular office work in Civil Courts. The pupils are principally drawn from the Hindú, Muhammadan, and Sikh sacerdotal classes, as well as from the *Munshi* class. They come chiefly from the indigenous schools in this as well as in other Provinces and territories, and a few also from Government Schools and the north-western frontier of the Punjab.

The College is managed by a Special Committee under the control of the Syndicate of the Punjab University. The endowed Fellowship-holders of the Punjab University (excepting the Medical Fellow who gives weekly lectures to *Hakims* and *Vaids* in the Medical School) give three hours of their time daily to teaching in the College.

The average number of scholars on the roll during the year 1882-83 was as follows:—

College Department, Male	124
Ditto Female	1
School Department, Male	128

The result of the education given as tested by public examinations up to the year 1883, or during a period of 12 years, has been as follows:—

Number of candidates from the Oriental College who passed each kind of examination.

Arts	Entrance	96	
	Proficiency or Intermediate	27	
	High Proficiency or B. O. L Degree	4	
	Honors, M. O. L. or M. A. Degrees	5	
			132
Sanskrit	Proficiency in	52	
	High Proficiency in	31	
	Honors in	14	
			97
Arabic	Proficiency	68	
	High Proficiency	41	
	Honors	22	
			131
Persian	Entrance	117	
	Proficiency	76	
	High Proficiency	39	
			232
Punjabi	Proficiency	23	
	High Proficiency	7	
	Honors	1	
			31
Pushtu	Proficiency	5	
			5
Professional	Medicine, Yunani system	36	
	Do. Vaidyak do.	15	
	Engineering, First	9	
	Do. Final	1	
	Law, Hindú	10	
	Do. Muhammadan	16	
			87
	Total		715

The annual expenditure of the Oriental College amounts in round numbers to about Rs. 32,000.

Full details of the teaching staff, income, expenditure, attendance and the like will be found in the Punjab University calendar and in the annual reports of the College itself.

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The Central Training College, Lahore.

This institution was established in December, 1880. The College was at first held in the old Normal School building in the Hazúrí *Bágh*, but this being unsuitable, the classes were, on the 16th July, 1881, transferred to the Government College building, where four rooms on the ground floor of the north-western wing were assigned to it. The Training College is intended, not so much to communicate knowledge, as to train men for the practical art of teaching and school management. Its scope is wider than that of the ordinary Normal School of the Province, which prepares young men for the charge of Vernacular Primary Schools only; whilst the Training College undertakes to train students, both in English and Vernacular, for the Middle and High Schools of the Province.

The Training College consists of two classes, a Vernacular and an English class, each to contain 30 students, for whom scholarships are provided. The Vernacular class of the Central Training College consists chiefly of picked men from the three Normal Schools of Lahore, Delhi and Ráwalpindi who have completed their course at these schools and have obtained certificates. A few, however, are men who have passed the Entrance Examination of the Punjab University on the vernacular side, and some are young teachers sent in from schools. The English class consists of students who have passed the B. A. or F. A. Examination, and of young teachers selected by the Inspectors of Schools as likely, by their character and capacity, to profit by the training afforded. Arrangements are made to enable these teachers to retain their salaries while under training.

The Staff consists of the Principal, who is a European, and has special charge of the English class; the Assistant Superintendent, who is a native, and has special charge of the Vernacular class; and a Maulvi for the Persian and Arabic of the Vernacular class. The institution is under the control of the Director of Public Instruction, Punjab. The course of instruction consists mainly of lectures on the principles of teaching, and of practical training in the art of teaching, to which are added a course of instruction in Elementary Science (Physics, Chemistry and Natural Phenomena) illustrated by experiments, while considerable attention is paid to the principles and practice of translation and retranslation, Persian and Urdu in the Vernacular class, and English and Urdu in the English class. The practical training in the art of teaching is three-fold: (1) Observing the teachers of the Model School attached to the College at their work, and recording their impressions in a note-book; (2) occasional teaching of a class of the Model School; (3) lessons in the presence of the students and the Principal, the performance being criticised by the students and the final judgment summed up by the Principal.

In March, 1883, a Model School was established to afford scope for the practical training of the students in the art of teaching. It is located in the building near the Senate House, lately occupied by the Anárkali Girls' School, and contains all the classes of a Primary and Middle Anglo-Vernacular School.

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Schools and Colleges.

Mayo School of Art, Lahore.

The establishment of a School of Art for the Punjab was talked of for some years before it came to pass. In 1864, especially when the first Exhibition of Punjab products, art and manufactures gave a special interest to the subject, the project was discussed, and Mr. B. H. Baden-Powell in his handbook of the manufactures of the Province, published in 1872, speaks of it as having been definitely determined upon, and among the reports embodied in that work it is frequently referred to as essential to the improvement of the arts of the country. In March, 1872, a public meeting was held at Lahore for the purpose of establishing some suitable memorial in honor of the late Lord Mayo, Viceroy and Governor-General of India, whose assassination had created a profound sensation throughout the Empire. The subscriptions amounted to Rs. 68,119. There was some diversity of opinion as to the form the memorial should take, and it was not until the 24th March in the succeeding year (1873) that the question was settled. Mr., now Sir, Lepel Griffin in an eloquent speech delivered at a meeting of the Central Mayo Memorial Committee proposed that the money should be expended on a School of Art and design in which industrial education should be given, the memorial funds to be spent only in erecting the necessary buildings, including appliances and fittings, and that Government should be asked for a grant-in-aid towards carrying out the objects of the institution. This proposal was unanimously accepted.

The question of the exact nature of the instruction to be given in the school was entered into at some length, and the opinions given were mostly in favour of a technical and industrial course, which should include, besides design, the study of Mechanics, Chemistry and Botany. The use of English machinery on an extensive scale was contemplated by some of the authorities consulted. But when the Government of the Punjab accepted the offer of the Mayo Memorial Fund Committee and consented to take charge of the new institution, the whole project was submitted to the Secretary of State for India with a lengthy minute by Sir Richard Temple on the principles on which a School of Industrial Art should be conducted in India. On the 24th September, 1874, the Secretary of State expressed his concurrence in Sir Richard Temple's opinion "that the object kept in view should be instruction in drawing and designing rather than in mechanical work, the latter being in fact treated as purely subordinate and supplementary to the former." The same despatch sanctioned the appointment of Mr. J. L. Kipling, Professor in the Government School of Art, Bombay, as Principal of the new institution. In April, 1875, Mr. Kipling arrived at Lahore, and operations were begun in a large house in Anárkali pending the erection of a suitable building.

The objects of the institution were, it will be seen, modified by the decision of the Secretary of State from the originally large and comprehensive programme which would have involved the employment of a large staff of teachers of special attainments. The first two or three years' experience demonstrated that the youths of the industrial classes who presented themselves were

Mayo School of Art, Lahore.

scarcely likely to benefit by courses of instruction in European mechanics and science, and that for some years at least a humbler and more elementary course was more suitable. It should also be noted that since the first discussion of the project, a great change has come over the opinion of those best qualified to speak on the cultivation of the Arts in India. It is now felt that the rational method of procedure in this, as in other fields of effort, is to find a starting point in already existing conditions, and to base instruction as far as possible on traditions and ideas already familiar to the people. If this is true of literary, social and political advancement, it is ten times true of Art. The revival and development of Indian Industrial Art is now acknowledged to be the true object of an Art School in this country in preference to the introduction of purely European styles and methods.

The School of Art building was erected on a design modified from drawings by the Principal. It is situated in the Anárkali Gardens between the Museum and the Band Stand. The lower story was used as part of the Punjab Exhibition held in the winter of 1881. In the spring of 1882 the whole building was occupied. The material is brick, and the style may be described as late Mughal. There are five rooms on the ground floor and an upper story lecture room 64 feet long by 24 feet wide.

A portion of the temporary buildings for the Exhibition was retained and adapted for use as carpenters' moulders' and potters' workshops. A plaster kiln is detached from the workshops.

The cost of the whole of the buildings was Rs. 43,000.

The staff of the School is composed of the Principal, two trained assistants, and an instructor in modelling and moulding. Rs. 135 per mensem are given as scholarships at the discretion of the Principal in sums of not more than Rs. 10, or less than Re. 1.

An extract from the prospectus of the School will give an idea of the general management:—

Elementary Training.

"Each student must pass through a course of elementary training including—

"(1) Black board demonstrations of the principles of drawing, outline from the flat, Elementary Geometry.

" (2) Outline from the round, Rudiments of Perspective.

"(3) Light and shade from the round, Plant drawing from nature, Elementary study of color.

"On the completion of this course provision will be made for special and technical instruction suitable for architectural and lithographic draughtsmen, potters, wood and stone-carvers, engravers on metal and wood, embroiderers, furniture-makers, &c.

Advanced Instruction.

"The advanced studies of the School include the principles of Oriental design, modelling from example and from nature, moulding and casting in plaster, paper casting, Gesso work, gilding, decorative painting, architectural drawing, advanced perspective, studies in color of still life, drawing from the living model in black and white, painting from living model, modelling from living model, &c.

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Admission to the School.

"Candidates who are sons of craftsmen and between 13 and 18 years of age are preferred. For the present no fees are charged; and the School supplies drawing materials, except lead pencil and India rubber. Each student will be considered a probationer for two months, after which period, should he appear in the judgment of the Principal to give no promise of satisfactory progress, his further attendance may be dispensed with.

"The School is intended not only for the use of students from Lahore, but from the whole Province and other places."

The expenditure and number of pupils for each of the last five years are:—

Years.	No. of pupils.	Expenditure.
		Rs.
1878-79 ...	58	13,330
1879-80 ...	55	13,759
1880-81 ...	50	14,263
1881-82 ...	43	14,330
1882-83 ...	55	14,019

Medical School, Lahore.

The Medical School was founded in the year 1860 to instruct the natives of the Punjab in medicine, it having been found that the Bengali doctors were not so acceptable to the inhabitants of the Punjab in the capacity of medical men as their own fellow-countrymen were, and also that the Bengalis were always anxious to return to their own country.

Dr. J. B. Scriven was the first Principal, and in conjunction with Dr. Manners Smith, Civil Surgeon of Lahore, commenced the School in October, 1860, and Dr. Brown, the present Principal, joined the staff in the December of the same year. The School was first held in an old barrack on the site of the present Government College, and the hospital was formed in a building in the Tibbi bazar formerly used as a stable. At first there was some difficulty in obtaining pupils for the English class, but this was gradually increased, though the full number of this class (25) was not obtained till the fifth year.

In 1870 the Mayo Hospital was opened and the practical teaching of the Medical School commenced in it.

In 1883 the new buildings of the Medical School were completed and used for the purposes of the School. These buildings are situated on the south of the Mayo Hospital with which the edifice is in exact keeping; the style of architecture is Italian, and the School consists of a one-storied building consisting of a centre and two wings at right angles. In the centre is a large hall used as a library and office and one large and two smaller lecture rooms; in the east wing is the dissecting room and the museum, and in the west wing the chemical laboratory and museum. The building cost Rs. 1,15,000 and was constructed in the short space of one year. In 1883 there were in the School the following classes and divisions and students in each class:—

Medical School, Lahore.

English Class.

Punjab Government students	13
N.-W. Provinces Government students	20
Punjab free students	13
N.-W. Provinces free students	6
Local students	11
Mission students	1
	64
Civil Medical pupils	13
Total	77

Hindustani Class.

Military Medical pupils	10
Civil Medical pupils	31
Hakim students	16
Local fund students	26
Free students	6
Mission students	1
Total	90

Affiliated Classes.

Practising Hakim and Baid class	20
European Midwife class	9
Native Midwife class	21
Total	50
Grand Total of Students	217

The number of the Licentiates in Medicine and Native Doctors who passed out of the School up to 1883 is as follows :—

Licentiates in Medicine	104
Native Doctors	363
Total	467

The expenditure on the School during 1882-83 was Rs. 72,296.

Mayo Hospital, Lahore.

The Mayo Hospital is a large double-storied building, situated on the south side of the city of Lahore, in the Italian style. It is 408 feet long, 51 broad, and its highest tower is 120 feet high. It consists of a centre used principally as offices, out-patient rooms, dispensary operating room, &c., and two wings placed a little back in echelon containing four large wards. The cost of the building was Rs. 1,58,941. The Earl of Mayo when Viceroy visited the building shortly after its being opened in 1871 and consented to its being called the Mayo Hospital. During the year 1882 there were the following patients treated in the hospital :—

In-patients	2,012
Out-patients	32,614
Total	34,626

Among the in-patients were 200 Europeans or Eurasians for whom there is not proper accommodation at present. It is however intended that a new European hospital should be built near the Mayo Hospital, and the plans have been drawn up. During 1883 there were

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660 major and 2,436 minor operations performed in the Mayo Hospital, with only 10 deaths. The expenditure in the Hospital was :—

Diet of patients	Rs.	6,289
Attendance	"	6,342
European Medicines, &c.	"	5,160
Country Medicines	"	1,111
Miscellaneous	"	3,294
Buildings	"	3,559
Total Rs. ...		25,755

The staff of the Hospital consists of a Principal, two Professors, four Readers, and a resident House Surgeon.

Lahore Veterinary School.

This School, or College, was established in 1882 "to educate and turn out a class of native veterinarians corresponding to the class of native hospital assistants." The reasons for its establishment may be briefly stated. The cruel and wasteful loss of animal life, both of Government and private property, for want of scientific help other than could be afforded by the few European veterinary surgeons in Military employ had long been felt throughout India, but little attempt had been made to create a useful class of native veterinary practitioners. Only at Poona did any Veterinary College exist. The Cattle Plague Commissioners in 1871 urged upon Government the expediency of affording to the natives of India the means of veterinary instruction, and in 1876 the Stud Commission brought the same subject prominently to notice. During the Afghán War in 1878-80 the mortality among transport animals greatly crippled the army, and in order to prevent the spread of infectious disease a veterinary surgeon and a staff of native "salutris" were placed on the main roads in the Punjab leading to the Khaibar and Kuram passes. Even for this duty a sufficient number of trained salutris were not forthcoming, and students from Hapdar School who had not completed their studies were placed on the staff of this officer. The school at Hapdar was begun on a small scale by the General Superintendent of Horse-breeding Operations, and was transferred to Lahore when the Hapdar depôt was abolished in 1881.

The Lahore Veterinary School was opened on the 3rd of May, 1882, with 50 students, and contains lecture rooms, a hospital, a dissecting room, a forge, and stabling for a large number of horse and cattle patients. It is situated close to the Mayo Hospital. The staff consists of a Principal, who is Professor of Veterinary Surgery and Medicine, and an Assistant Professor, who lectures on Anatomy. The students, whose number is at present limited to 60, attend the lectures on Chemistry and Materia Medica at the Medical College. A proportion of the students are native cavalry soldiers; others are Civilians, sent and supported by the District Committees; others are independent. They are carefully trained in the practical part of their profession—handling and examining animals, shoeing horses, performing all kinds of operations, and administering drugs. As both horse and cattle diseases are studied, it may be expected that these men will be of great service, especially in mitigating the losses from cattle plague, and that they will in time work a reform in the treatment of lame and diseased animals generally throughout the country.

Chapter VI, D.

Literary Societies.

General Remarks.

SECTION D.—LITERARY SOCIETIES.

The number of societies of a literary character which have been registered under the Act in that behalf is very small, and comprises the Libraries and Reading-rooms at Lahore and Delhi which are maintained by the European communities at those stations. The number of unregistered societies which have been formed in the Punjab is on the other hand very large, and has increased considerably within the last ten years. The oldest society in the Punjab is the *Anjuman-i-Punjab* of Lahore, which was founded in 1865. Of late years branch *Anjuman* or Anjumans on a similar model have been formed at many of the large towns in the Province. These societies are open to all respectable and educated persons upon election and payment of a small subscription, and are useful representatives of public opinion. The bulk of the members are natives. Societies have latterly grown up having a special religious or national characteristic. The *Indian Association*, the *Arya Samáj* and the various branches of the *Anjuman Islámia* are examples of these. On their secular or general side they are literary societies merely. Several of the more important societies publish their own journals, while others are more or less represented by particular newspapers. The Anjuman-i-Punjab publishes an English and Urdu journal in furtherance of its objects. The Indian Association is represented by the *Tribune* newspaper, and forms a link between the Lower Provinces of Bengal and the Punjab. The Arya Samáj supports a small journal, while several newspapers advocate the views of other smaller societies and are more or less closely connected with them. The following is a short account of the leading societies having a literary aspect, written by Mr. E. W. Parker:—

The Anjuman-i-Punjab.

This Society, as has been stated, was founded in 1865, chiefly owing to the efforts of Dr. G. W. Leitner. It was at first called the *Anjuman-i-Isha'at Ulúm-i-Mufida Punjab*, a name which indicated the chief objects held in view. These were more fully described as being—(1) the revival of ancient learning; the philology, ethnology, history, and antiquities of India and neighbouring countries; (2) the advancement of knowledge among the masses through the medium of their own vernaculars; (3) the promotion of industry and commerce; (4) the discussion of social, literary, scientific and political questions of interest; the popularization of beneficial Government measures; the development of a feeling of loyalty and of a common state citizenship; and the submission to the Government of practical proposals suggested by the wishes and wants of the people; (5) the association of the learned and influential classes with the officers of Government in all measures for the public good.

There are standing Committees representing the various departments of work, and some departments have developed into separate but affiliated societies. An industrial society and a society of poets (Anjuman Musháira) have thus grown up, while the educational efforts of the Society originated the movement for a Punjab University which has lately been crowned with success. A public library and reading-room are maintained in the city, and public

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The Anjuman-i-Punjab.

lectures are arranged for and delivered. The Society is under the distinguished patronage of His Royal Highness the Prince of Wales and of the Lieutenant-Governor for the time being. The list of members numbers about three hundred, and includes gentlemen of all creeds and races in the Punjab, the chief aim of the association being to provide a platform for public opinion of every shade. It has founded several schools, and has collected large sums of money at various times for public purposes.

The *Anjuman Musháira*, a branch of the Anjuman-i-Punjab, has for its object the encouragement of the composition and translation of poems of a higher character than has hitherto been favoured by Orientals. In it the leading poets meet together and recite their poems for their mutual edification. A periodical is issued from time to time containing the best poems which have been laid before the Society. The Industrial Society is also a branch of the Anjuman, and has been formed for the purpose of disseminating information on subjects of industry and of the industrial arts among the artizans and art workmen of the Province, and of supervising the due execution of orders for manufactures by means of its members or by branches of the Society in various parts of the Province. An industrial society has been established for exhibiting specimens of native manufactures, suggesting improvements in their designs, &c., and for getting orders for native-made articles executed with promptness, punctuality and care.

The Gúru Singh Sabha.

The *Gúru Singh Sabha* of Lahore is affiliated to the Anjuman-i-Punjab, but has for its special object the representation of the Sikh community and Sikh interests. It is endeavouring to improve and enrich Punjabi literature by the aid of Western science; it gives the improvement of agriculture prominent place in its deliberations, and professes to take a deep interest in promoting female education. On its religious side this Society endeavours to interpret more truly the teachings of the A'di Granth and other sacred books, and to demolish false doctrines and improper customs. Its organ is a weekly Punjabi journal bearing the name of the Society.

Anjuman-i-Islámia, Lahore.

The Anjuman-i-Islámia was established in 1869, since when it has founded an Anglo-Muhammadan school, has been instrumental, partly with the help of the Anjuman-i-Punjab, in collecting over Rs. 20,000 for the wounded in Turkey, and has materially assisted in repairing the Imperial and golden mosques at Lahore. It discusses all questions affecting the Muhammadan community, and its meetings are open to both Súnnís and Shíáhs. Its proceedings are reported in the journal of the Anjuman-i-Punjab. Its aims are to popularize Government measures affecting Muhammadans, and to submit suggestions from that community to Government.

Sat Sabha, Lahore.

The objects of the Sabha on its secular side are—(1) the diffusion of useful knowledge by Punjabis, and (2) the reformation of the moral and social conditions of the Hindús.

Anjuman-i-Hamdardi Islámia, Lahore.

This Anjuman was established in 1880. Its objects on the secular side correspond with those of the Anjuman-i-Punjab. Membership on the secular side is open to Hindús, Shíáhs, Muwahidíns and Súnnís, &c. The Anjuman on its religious side has a

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monthly magazine called *Risála Isha'at-us-sunat*, and its proceedings are published in the Urdu journal of the Anjuman-i-Punjab and the Ishait-us-sunat.

Hindú Sabha, Lahore.

This Society was founded in 1882. It discusses all social, political and religious questions concerning India. It meets occasionally in the house of Rája Harbans Singh.

Sanskrit Pracharini Sabha, Lahore.

This Sabha was founded in 1882, and its special object is to encourage the study of the Sanskrit language among the Hindús.

Bhásha Pracharini Sabha, Lahore.

This Sabha was founded in 1882 to advocate the cause of the Hindi language.

Anjuman-i-Himáyat Urdu, Lahore.

This Anjuman was founded in 1882 by the partisans of Urdu to advocate the cause of that language against Hindi.

The Indian Association, Lahore.

Is a branch of the Indian National Association, Calcutta, and its objects are the same as those of that Society.

Anjuman-i-Kasúr.

This Anjuman was founded about 1870 by Munshi Ghulam Nabi, the then Extra Assistant Commissioner, and Munshi Kadir Bakhsh, the then Tahsíldár at Kasúr. The objects of the Anjuman are to encourage education among the masses and to improve indigenous industries and arts. The Anjuman has a flourishing Anglo-Vernacular school, a *Kárkhána* of indigenous industries, and a well-conducted monthly magazine in Urdu.

Anjuman-i-Farzán-i-A'm, Gujránwála.

This Society was founded in 1866 under the patronage of Colonel Babbage, late Deputy Commissioner, and Rái Gopál Dás, who was then an Extra Assistant Commissioner in the Settlement Department. A free public library and a reading-room were also opened in the Báráda*r*i in Sardár Mahan Singh's gardens, and a large number of books of different languages, relating to sciences and arts, were obtained. Several English and Vernacular newspapers are also taken for public use. It is called the "Babbage Library." There is also a museum belonging to this institution in which manufactures of different sorts, collected from this and other districts, and pictures of several Rájas and Chiefs, are kept for public show. It is called the "Harington Museum."

Anjuman-i-Islámia, Gujránwála.

This institution was established in 1875. Discussions are held on various subjects relating to the welfare of the Muhammadan community. The Society has opened a school called "Madrassa Islámia," in which religious, scientific and other books of Arabic and Persian literature are taught according to the Lahore Oriental scheme. Several boys from this school have passed the Oriental Examinations of the Punjab University. A subscription to meet the expenses of the school is raised by the citizens, and an equivalent grant-in-aid, which amounts to Rs. 50 per month, *viz.*, Rs. 30 from Municipal Funds and Rs. 20 from District Funds, is received. The Punjab University also assists this institution by a donation of Rs. 15 per mensem. Hindús can join as members, and children of every caste and creed can enter the school.

Social Club, Ferozepore.

In Ferozepore there is a small Club which was founded about a year ago by some of the educated natives connected with the public offices, which is called the "Social Club." The objects of the Club are stated to be social reform and intellectual improvement. Meetings are regularly held once a week, in which essays on various subjects are read.

Chapter VI, D.

Literary Societies.

Anjuman Islámia, Amritsar.

This Anjuman was founded in 1874. Its objects are the encouragement of English and religious education among the Muhammadan community, and to discuss social, political and religious matters affecting Muhammadans. A large number of respectable Mussalmáns of the town have joined this Society. It has a school attached to it attended by 150 pupils.

Majlis Islámia, Amritsar.

This Society was founded in 1882 by the Mowáhids (Wahábís) of the town. They are endeavouring to raise a sum by subscription among themselves to start a school.

Hindú Sabha, Amritsar.

The special objects of this Society are the diffusion of the Sanskrit language and the social reformation of the Hindús. It was founded in 1882.

Majlis Akhlaqia, Amritsar.

This Society was founded in 1882. Its object is to effect moral and social reforms among the natives. Both Hindús and Muhammadans are permitted to become members. It has a paper in Urdu, called *Akhbár Majlis Akhlaqia*, Amritsar. Lectures on literary and scientific subjects are now and then delivered.

Arya Samáj, Amritsar.

This Society was founded in 1882. The special object of this Samáj is the diffusion of the Vedic religion.

Union Council, Amritsar.

This Society was founded only a year ago. Almost all the pleaders and other educated natives have joined its list of members. It discusses the general topics of the day.

Singh Sabha, Amritsar.

The object of the Sabha is the diffusion and reform of the Sikh religion. It meets at the Darbár Sáhib.

Anjuman-i-Rafáh-i-A'm, Ludhiána.

The only Society in the Ludhiána District is the Anjuman-i-Rafáh-i-A'm, which was started recently.

Bharíti Sabha, Dera Ismail Khan.

This is a Hindú Club, which holds weekly meetings in which lectures on general, moral and social subjects are delivered and discussions take place. No political subjects are allowed. Every subject discussed is reported to the Deputy Commissioner. The Sabha was founded in February, 1882.

Anjuman-i-Pesháwar, Pesháwar

This is the only Society in the district. It was founded some years ago by the Reverend T. P. Hughes. The Society has a newspaper called *Akhbár Anjuman-i-Pesháwar.*

Anjuman-i-Hazára, Hazára.

This is the only Society in the district. Its objects are similar to the Anjuman-i-Punjab.

Anjuman Rafáh-i-A'm, Umballa.

This association was established in May, 1882. The aims and objects of the association are the social, moral and political advancement of the native communities in general, and of Umballa City in particular. As it counts among its members men of different religious denominations, the discussion of religious topics is strictly prohibited. The Anjuman subscribes to several newspapers, English and Urdu, for the entertainment of its members. A proposal to establish a vernacular press and Urdu newspaper is under consideration of the Society. The Society had a little Art school, or rather a carpentry business, attached to it and supported by its funds, with a view to teach that useful art to young men willing to learn it. This Art class, much to the regret of the association, has lately been abolished for want of means.

Delhi Literary Society.

The *Delhi Literary Society* has long been established. It holds its meetings in the upper rooms of the Delhi Institute. The Society cannot be said to perform any literary functions at present, as the

Chapter VI, D.

Literary Societies.

members are mostly non-literary. Still it will always afford a nucleus for a literary society if any enterprising native would take it up.

Anjuman Islámia, Delhi.

Another society in Delhi is the *Anjuman Islámia*, which meets in the Chándni Mehal, the residence of the President, Mirza Sulemán Sháh. The Society was at one time in a flourishing condition, but this is not now the case.

St. Stephen's Club, Delhi.

The Reverend Mr. Allnutt also reports that there is, in connection with St. Stephen's College, a club which to a certain extent is a literary society. It meets once a fortnight, and scientific and literary debates and discussions are held, both in English and vernacular. The Club has about 100 members, and, as the College grows, will doubtless become a more useful and important institution.

SECTION B.—THE FRONTIER.

Chapter VII, B.
The Frontier.

The North-West Frontier of the Punjab comprises the six districts of Hazára, Pesháwar, Kohát, Bannu, Dera Ismail Khan, and Dera Gházi Khan; the line of frontier being conveniently held to extend from a point on the river Jhelum, half way between the hill sanitaria of Abbottabad and Murree, running due north with the Kaghán ranges into the high Himalayas, nearly to Chilás, and then descending to the south till it touches the Indus where that river emerges from the hills at Torbeyla. Turning to the west to enclose the fertile plain of Yusafzai, it again takes a southerly direction, where it crosses the Swát river, and, from that point, descends almost due south till it touches Kasmor on the Indus, on the border of Sind. The frontier line has not everywhere been strictly defined, and the boundary shown on maps is often merely that of the topographical survey, the limits of which were influenced by considerations of departmental convenience, and not of general policy. Two of these districts, Hazára and Kohát, are hilly and, in parts, mountainous. The other four are almost level plains, only broken by deep ravines and torrent beds which make even the Pesháwar Valley difficult for the movements of cavalry and guns. The characteristics of the people inhabiting them differ almost as much as the characters of the districts themselves. The principal tribes will presently be noticed in some detail. The frontier itself is some 704 miles in length, as shown in the following table:—

District.	Population, 1881.	Area in square miles.	Revenue, 1882-83. Land.*	Revenue, 1882-83. Gross.	Length of district in miles.	Length of Frontier in miles.
			Rs	Rs.		
Hazára ...	407,075	3,039	2,21,932	2,87,293	95	120
Pesháwar ...	592,674	2,504	6,82,010	9,59,311	50	170
Kohát ...	181,540	2,973	89,098	1,44,777	50	60
Bannu ...	332,577	3,868	3,45,420	5,49,531	55	60
Dera Ismail Khan	441,649	9,269	4,62,970	5,94,223	102	124
Dera Gházi Khan	363,346	4,517	3,50,203	4,97,398	170	170
Total ...	2,318,861	26,170	21,51,633	30,32,533	522	704

*Excluding revenue collected by the Canal Department.

Principal Frontier Tribes.

Detailed accounts of the names and characteristics of the tribes that fringe the British border, from Hazára on the north to Sind on the south, have been given in the published report of Mr. (now Sir R.) Temple, showing the relations of the British Government with the tribes on the north-west frontier of the Punjab, and in subsequent Reports and Gazetteers. It may be convenient here to state briefly that the clans belong to two distinct races. From Hazára to Dera Ismail Khan they are, with a few insignificant exceptions, of Pathán origin, and thence to Sind they are Bilúch. The names of the principal tribes, and the estimated number of their fighting-men, are as follows:—

Principal Frontier Tribes.

Locality.	Tribe.	Race.	Number of fighting-men.
Adjoining Hazára	Swátís ...	Allied to Patbán	...
	Akazais	Pathán	500
	Hassanzais	Pathán	1,700
Adjoining Pesháwar	Gadúns	Pathán	2,500
	Búnérwáls	Pathán	2,000
	Inhabitants of Swát	Pathán	6,000
	Utman Khels	Pathán	5,000
	Mohmands	Pathán	16,000
Adjoining Kohát and Pesháwar	Afrídís	Pathán	23,500
Adjoining Kohát, Bannu and Dera Ismail Khan.	Orakzais	Pathán	29,500
	Zaimúkht Afgháns	Pathán	4,500
	Túrís	Pathán	5,000
	Wazírs	Pathán	44,000
Adjoining Dera Ismail Khan	Shiránís	Pathán	5,000
	Ushteránas	Pathán	900
	Kasránís	Bilúch	1,500
Adjoining Dera Ghází Khan	Bozdárs	Bilúch	2,700
	Khetráns	Pathán & Bilúch	4,500
	Kosas	Bilúch	4,000
	Lagháris	Bilúch	3,700
	Gúrchánís	Bilúch	1,200
	Marrís	Bilúch	2,500
	Búgtís	Bilúch	1,500
	Mazárís	Bilúch	2,000
		TOTAL ...	180,900

The numbers here given differ in some cases from those furnished in other Reports; but the present statement has been carefully compiled, and is believed to give as near an approximation to the true numbers as can be attained. They comprise all the adult males of the tribe who are capable of bearing arms, but it would in no case be probable, or even possible, that a tribe could unite for any purpose much more than half its strength, except in the presence of extreme danger threatening the safety or independence of the whole tribe.

The Bilúch-Afghán Boundary. The extreme difference between these races.

The boundary between the Afghán and Bilúch tribes is ordinarily fixed at Vihowa, opposite Dera Fatah Khan, and at the southern extremity of the Dera Ismail Khan district. This point has been somewhat arbitrarily fixed, but, as a general rule, it may be said that all the tribes *north* of this point are *Afghán*, and all below it, with the single exception of the Khetráns, are *Bilúch*.

Between these races there is, so far as their national and political constitution is concerned, little in common. While both the Afghán and Bilúch communities are in the tribal phase of social progress, the organization of the former resembles the germ from which democratic institutions may have arisen, whilst in the constitution of the latter may be traced the rudiments from which monarchical principles may have been developed. The Bilúch tribes have thus a tendency towards an aristocratic and oligarchical form of government, rendering obedience and service to their acknowledged Chiefs, who are thus the natural channel of communication with their tribesmen, and through whom any desired amount of control can be effectively exercised. This manner of influencing the Bilúch tribes has for many years past been followed in the Dera Ghází Khan district, and generally with success.

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The Frontier.

The Bilúch-Afghán Boundary. The extreme difference between these races.

With the Afgháns to the north such a system of management would be useless. Their national constitution inclines rather to the republican than the aristocratic. Every tribe is divided and sub-divided into numerous clans, each independent of the others, and yielding but small obedience to its own petty headmen, constantly indulging in internecine war; hating each other with the hatred begotten of generations of blood feuds, with interests ever in collision, and only uniting, under the most exceptional circumstances, against a common enemy. Control exercised over such tribes through their Chiefs would be weak, for the Chiefs exercise but little real power. With them the only policy which showed hopes of success was, in peaceful times, to render the whole tribe friendly by conciliatory, just and liberal treatment, and by encouraging their settlement in British territory; and, when times of difficulty arose, to divide the hostile tribe by playing the interests of one section against those of the others.

Superiority of Bilúchís over Afgháns.

One great superiority of Bilúchís over Afgháns is their freedom from religious bigotry. Afgháns are blindly subservient to their priests, and this is the chief reason that European life is so insecure in their hills, while it is safe among the Bilúchís, there being no instance on record of a European being assassinated by them. The character and influence of the Afghán religious teachers have been described by many writers. The *Tálibân-ul-ilm*, or "seekers of wisdom," half students, half secular priests, swarm in the mosques, leading an idle life and ever ready to incite their clansmen to mischief. They are ignorant and fanatical in an extreme degree. Where life is easy and food cheap, as in the Swát and Daur Valleys, they most abound, and with reference to the last-named tract, it is notorious that to the dictation of these priests are the Daurís indebted for any exhibition of martial spirit which they may have ever shown. The entire absence of religious bigotry in the Bilúchís makes their control comparatively easy, for there is not the perpetual fear of some outbreak of fanatical rage against the infidel, which, to the north and among Afghán tribes, has always to be guarded against. A brief account of the bordering tribes and of the system of frontier management will be found in the Gazetteers of each frontier district.

CHAPTER VIII.

PUBLIC WORKS.

SECTION A.—PUNJAB NORTHERN STATE RAILWAY.*

Early narrow gauge line.

The scheme for the construction of the system which is now the Punjab Northern State Railway first saw the light when the battle between the broad and narrow gauges was at its height. Some fifteen years ago orders were passed by Government for the line to be made on the broad gauge, but before construction began even, economy triumphed, and the line from Lahore to Jhelum was ordered to be made on the metre gauge, and to be laid by the side of the Grand Trunk Road, quitting it only when the railway passed over a river by an iron bridge, and the road by a bridge of boats or a ferry, according to the season. By September, 1873, this line was at work and crossed the three great rivers—Ravi, Chenab and Jhelum—on girder bridges adapted for the narrow gauge. This arrangement was but short-lived, for at the end of 1873 it was decided, chiefly owing to the remonstrances of Lord Napier of Magdala, then Commander-in-Chief, to sever the unnatural alliance with the Grand Trunk Road and give the rails an embankment of their own. Finally in July, 1874, an entire reconstruction on the broad or 5-foot 6-inch gauge was decided on, and since June, 1883, there has been a line of communication without break of gauge from Peshávar to Calcutta, Bombay and Madras.

Reconstruction on the broad gauge.

Financial nature of the line.

For financial purposes the Punjab Northern Railway is divided into two sections—one from Lahore to Ráwalpindi, including the Salt branch, which is classed as a "productive public work" and may be expected to give a fair return for the capital expended on it; and another from Ráwalpindi to Peshávar, with a branch to Khusalgarh, which is a "frontier line," constructed with a view rather to military potentialities than as a commercial undertaking. As a matter of fact, however, the productive part of the line may be said to terminate at Jhelum.

Dates of opening and lengths of Sections.

The dates of opening the various sections of the line for public traffic and the length of each section are given below:—

		Miles.
Temporary line	Lahore to Wazirabad, 12th April, 1875	62
	Wazirabad to Naurangabad, 10th April, 1876 ...	30
	Naurangabad to Jhelum, 14th September, 1876 ...	3
	Total	95
Main line	Lahore to Jhelum, 6th October, 1878	103
	Jhelum to Ratial, 1st January, 1880	15
	Ratial to Ráwalpindi, 1st October, 1880	56
	Ráwalpindi to Attock, 1st January, 1881 ...	63
	Khairabad to Peshávar City, 1st May, 1882 ...	41
	Peshávar City to Peshávar Cantonment, December, 1882	2
	Total	280

* The Punjab Northern State Railway now forms a section of the North-Western State Railway.

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Dates of opening and lengths of Sections.

		Miles.
Khusalgarh Branch	Golra to Langar, 1st April, 1881	64
	Langar to Khusalgarh, 16th April, 1881	8
	Total	72
Salt Branch ...	Lala Musa to Bahauddin, 1st January, 1880 ...	29
	Bahauddin to Hariah, 1st February, 1880 ...	10
	Hariah to Miani, 10th April, 1880	15
	Miani to Bhera, 2nd February, 1882	10
	Pind Dadan Khan to Khewra, 15th January, 1883 ...	5
	Total	69
Siálkot Branch ...	Wazirabad to Siálkot, 1st January, 1884	26
	Total	26
	Total open mileage ...	447

Of the above the whole is on the 5-foot 6-inch gauge except the Salt branch, which is a metre gauge line; the rails used being those formerly laid down on the main line. In August, 1874, the first engine was run through from Shahdara (5 miles from Lahore) to Wazirabad, and the metre gauge line, which was well advanced when the decision to adopt the broad gauge was come to, was opened for traffic to that place on the 12th April, 1875, including the bridge over the Ravi.

Results of change of gauge.

It is not to be supposed that all these changes of gauge were effected without much waste of time and money, or that the final result is altogether satisfactory. The three great bridges over the Ravi, Chenab and Jhelum were designed and actually constructed for a metre gauge, and as building new bridges was out of the question, all that could be done was to set the girders wider apart, and even this did not fully meet the difficulty, for they were not intended to carry the weight of broad gauge trains, and it will always be necessary to use the bridges with great caution. Their history will be found below.

The country passed through by the line.

The eastern terminus of the Punjab Northern State Railway is at Lahore, where the station of the Sind, Punjab and Delhi Railway is used jointly for both lines. The Ravi is crossed about two miles from Lahore, and from this point the State railway runs nearly due north to Wazirabad, crossing somewhat diagonally the Rechna Doáb or country lying between the Ravi and Chenab.

Forming part of the great plain of the Punjab, this country is almost a dead level, and is extremely liable to be flooded during the rainy season, partly by torrents from the hills and partly by overflow from the rivers. Many miles of viaduct have been provided to afford an escape for the waters, as without them the railway embankment would form a dam right across the Doáb, against which the flood would accumulate and finally sweep all before it. The country on both sides of the line now appears in flood times to be a vast lake, but the water passes away harmlessly. The thriving towns of Gujránwála and Wazirabad are on this part of the line. Three miles beyond the latter the Chenab is crossed by the Alexandra bridge, and the general direction of the railway from here is towards the north-west till the Indus is passed, when it changes to due west. West of the Chenab is the Jech Doáb between

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Punjab Northern State Railway.

the Chenab and Jhelum, and here the great plain, extending in a level monotony from Patna upwards, comes to an end. The engineer who had hitherto been able to direct the course of his line with the aid of a map and a ruler now once more has to resort to curves and gradients, and from the Jhelum to Peshávar it is difficult to find a place where the line is either straight or level for more than a very short distance.

Passage through the Salt Range.

The rugged Salt Range, an offshoot of the Himalayan system, is crossed at the Ratial ravines. The country between the Jhelum and Ráwalpindi has a very singular appearance: in some places rugged trap dykes run for miles in parallel lines like walls; in others the soft soil has been scoured by the hill torrents into deep gorges and ravines, perhaps a hundred feet deep, leaving pinnacles and towers standing, looking like a dolomite range of crumbling earth. Crossing a country like this with a line of railway necessitated very heavy works. The principal ones are the Bakrala bridge over a nullah 80 feet deep below the rails; the Bishendore bridge, 86 feet high; and the Sohan bridge, 90 feet high. The bridges are almost always approached by deep cuttings and heavy gradients, and the last named is also on a sharp curve. Whilst these works were still far from completion the second phase of the Afghán War broke out, and it was essential that the line should be utilized for sending troops and material towards the front. This was done, but what the difficulties of carrying on traffic and construction at the same time were, those only who had to do the work can thoroughly realize.

Ráwalpindi is the most important station on the Punjab Northern Railway. It is the site of a large military cantonment; the town is not very large, the population being about 20,000. The country towards the west, though undulating, does not present the same engineering difficulties. Eight miles from Ráwalpindi is Golra, the junction station of the Khusalgarh branch. Between Golra and Hussan Abdul a range of hills is passed at the Margalla tunnel. Before the problem of the passage of the Indus had been solved, the line was carried down to the banks of the river close to the Fort of Attock, between which place and Khairabad, the station on the opposite bank, a bridge of boats afforded the means of communication in the cold season and a ferry during the hot weather. This was only a temporary arrangement whilst the great bridge was under construction. This bridge, which is described below, and is one of the greatest triumphs of engineering skill yet accomplished in India, was completed in May, 1883, formally opened on the Queen's Birthday, and on the 1st June the first through carriages ran from Peshâwar to Calcutta. The temporary line from Campbellpore to Attock was then abandoned.

After crossing the Indus the railway runs at the northern foot of the Kohát range, between it and the Kabul river, to Pesháwar, which is now, and will probably be for some time to come, the ultimate point reached by rail towards the north-west. The

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Punjab Northern State Railway.

Passage through the Salt Range.

completion of the last link in the chain of communication with the mouth of the Khyber is one of the important events of Indian history, and should we ever again be unhappily embroiled in war beyond the Afghán frontier, the conditions under which the campaign would be undertaken would be vastly more favourable than before.

The Kohát Branch.

As already stated, Golra is the junction station of the branch line, 72 miles in length, to Khusalgarh. This is an example of a railway constructed for military reasons *pur et simple,* the receipts from peaceful traffic paying but a fraction of the actual working expenses. The object was to bring the important position of Kohát within measurable distance of the railway, and though Nowshera and Pesháwar are but a little way on the map from Kohát, the Meer Kullan and Kohát passes intervene, the holding of which is a troublesome matter. Therefore this branch was made to turn the flank of the Kohát pass and afford an easy communication with Ráwalpindi. The line is carried down to the east bank of the Indus at Khusalgarh, where there is a bridge of boats or a ferry, according to the season, and Kohát is but 29 miles distant. The branch was not completed in time to take the troops proceeding on the Waziri Expedition in 1881, but brought them home again when they returned. During times of peace this line has a deserted appearance; its occupation is too evidently gone; half the stations are closed and the remainder are empty, but there it is; and if ever required, its arrears of idleness would soon be worked off.

The Salt Branch.

A very different branch is that from Lala Musa to the Salt Mines; this is the most profitable section of the whole system of the Punjab Northern Railway. In a deep gorge of the Salt Range near Khewra are the celebrated Mayo Salt Mines, where the beds of rock salt seem practically unlimited, and some 50,000 tons are excavated annually. In the neighbourhood also coal is found, and though of inferior quality small quantities of it are used on the railway.* The salt is taken by a tramway from the mouth of the mines to the station at Khewra, and from there by the railway to Pind Dadan Khan, 5 miles distant, on the right bank of the Jhelum. When the river is in flood the salt has to be ferried across in boats, and is loaded into railway waggons again on the other side at Miani, which is 54 miles from Lala Musa, the junction station with the Miani line. The branch is continued beyond Miani ten miles to the thriving town of Bhera, which does a large trade. During the cold weather, when the river is low, a temporary railway bridge is built across the Jhelum between Miani and Pind Dadan Khan, so that the trains can run right through. This bridge is liable to be carried away by sudden rises of the river, as was the case in the autumn of 1883, when it was destroyed almost immediately after it had been got ready for the season. Between Bhera and Lala Musa this branch

* Since the above was written the coal mines at Dandot in the Jhelum District have proved more productive than was expected, and it is anticipated that they will, when fully developed, supply fuel to the whole railway system of the Punjab.

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The Salt Branch.

runs through a flat fertile country parallel to the Jhelum, past numerous prosperous villages, to and from which there is a large traffic, the whole forming an agreeable variation from the country passed through by the main line, which is for the most part sterile and but thinly populated. At Lala Musa station huge warehouses were built with the intention of storing salt there before the rising of the river and so avoiding the troublesome and expensive ferrying process. But a change of policy on the part of the Salt Department has left them standing empty, and they have scarcely been used.

The Siálkot Branch.

Newest of the branches is the one from Wazirabad to Siálkot, 26 miles in length, opened for traffic on the 1st January, 1884. This line is in its construction of a somewhat experimental nature. In a level or nearly level country subject to floods the most usual practice is to raise the railway on an embankment above the flood line, and to provide waterways by means of viaducts and bridges for the escape of the flood water. This is obviously a costly method of construction, and if the necessary amount of waterway be under-estimated, the bank may be washed away, and its repair is expensive and takes a long time. The Siálkot branch, however, has been made as a surface line, which means that the sleepers are laid almost on the level of the ground, without any embankment at all. At intervals, for a length of some two or three hundred feet, there is a "depression" or place where the rails are lowered till their tops are actually on the ground level. The sites selected for these depressions are places where the water is observed to flow in flood time transversely to the direction of the line. The idea of course is, in the first instance, to save expense, but a free passage over the line being open everywhere, there will be no damming back of the floods, and there is no bank to wash away. A train can run through a foot or so of water, which would flow across without in any way injuring the rails, so that traffic could be kept going in everything but very high floods, which in the dry climate of the Punjab are always rare and of short duration. The district round Siálkot is amongst the most fertile of the Punjab, and the town itself is a large centre of various manufactures. There is every reason therefore to hope that the branch will be found profitable. Twenty-two miles beyond Siálkot is Jamu, the chief town of the Mahárája of Kashmir, who it is said, proposes to continue the railway thither from Siálkot at the expense of his State.

Head-quarters at Ráwalpindi.

The head offices of the Punjab Northern State Railway are at Ráwalpindi, and here too are the workshops, which are extensive, and fitted with all the necessary machinery for repairing and constructing the rolling stock. Since the opening of the line a large railway colony has been established with its own church, swimming baths, institute and barracks. Both the State and guaranteed railways find it the truest economy in India to take every possible care for the welfare of the European employés.

Open mileage, Capital expended and cost per mile.

The length of line open for traffic on the 30th June, 1883, was 421½ miles, on the construction of which, and the provision of

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rolling stock, workshops, &c., a capital expenditure of Rs. 7,13,20,596 had been incurred by the State. This gives the cost per mile of line open as Rs. 1,69,206. These figures do not include the recently-opened Siálkot branch line.

Profits of Working and Statistics.

As a commercial undertaking, it can hardly be said that the Punjab Northern State Railway has, up to the present time, been a success. Even in 1879 and 1880, its two best years, when the traffic was swelled by the war in Afghánistán far beyond its normal dimensions, the profits were only 1·54 and 1·40 per cent. on the capital expended, and in 1881 and 1882, ·58 and ·83 respectively, without the war traffic. In 1883 the line benefited by the expansion of the grain trade, though not to the same extent as some others. It is only quite recently, however, that the system has really been complete. The low receipts of that part which is avowedly not expected to pay of course raise the proportion of working expenses to earnings over the whole line. The trade through the Khyber to Afghánistán and Central Asia looks large when expressed in camel loads, but put them into goods waggons and the amount seems trifling. One goods train alone will carry as much as 1,000 camels. A very large increase in the trans-frontier trade would be required to add much to the earnings of the railway. Still the trade of India generally has shown lately such powers of expansion that it may reasonably be expected that eventually this line will give a fair, though probably never a large, return for the capital expended on it; more than this cannot be expected from a railway system more than a third of which is classed as non-productive.

The accompanying tables give the general results of working during the last five years; a return of the principal commodities carried in one year; the expenses of management; and lastly the number of passengers and tons of goods carried during each year for the five years ending with December 31st, 1882.

General Results of Working.

Items.		1878	1879	1880	1881	1882
Mean length open		Miles. 103	Miles. 103	Miles. 228	Miles. 343	Miles. 397
		Rs.	Rs.	Rs.	Rs.	Rs.
Earnings	Coaching ...	3,94,881	6,90,372	10,79,731	13,52,146	13,96,492
	Goods	4,92,804	10,99,774	18,78,514	19,89,004	16,34,178
	Sundries	21,886	59,935	4,10,038	1,28,414	99,842
	Total ...	9,09,571	18,50,081	33,68,284	34,69,564	31,30,512
Working expenses		9,03,761	14,71,192	28,04,113	31,09,966	26,21,494
Nett earnings		5,810	3,78,889	5,64,171	3,59,598	5,09,018
Capital expended on open line ...		1,71,07,578	2,45,80,202	4,04,24,501	6,19,34,964	6,10,71,973
Per cent. of profit on capital expenditure.		0·03	1·54	1·40	0·58	0·83
Average gross earnings per mile per week.		170	345	423	195	151
Percentage of expenses on earnings		99·36	79·52	83·25	89·64	83·74

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Profits of Working and Statistics.

Abstract of Principal Commodities carried during the year 1882.

Description.	Quantity.	Receipts.
	No.	Rs.
Animals	1,213	4,300
Borax	7	122
Canes and Rattans	1	36
Chinese and Japanese Ware	120	2,737
Coal and Coke	18,240	75,485
Cotton, Raw	211	4,456
Ditto Manufactured	4,805	96,478
Drugs and Medicines	237	4,514
Dyeing Material	1,163	17,138
Earthenware and Porcelain	19	447
Fibrous Products	1,786	14,436
Fruits and Nuts	3,911	63,469
Grain and Pulse	52,592	3,34,022
Gums and Resins	59	632
Hides and Skins	1,611	13,223
Horns	27	207
Lac	43	648
Leather	430	6,734
Liquors	2,800	30,948
Mats	105	1,131
Metals and Manufactures of Metal	6,178	41,361
Oil	1,455	22,850
Opium	1	2
Paints and Colors	43	753
Provisions	519	7,927
Salt	48,899	2,02,956
Saltpetre, &c.	221	1,485
Seeds	1,763	10,418
Silk	123	2,956
Spices	518	5,643
Stones and Marbles	3,046	6,811
Sugar	13,192	98,728
Tea	779	17,326
Tobacco	165	2,717
Wood	31,842	1,09,548
Wool	835	9,508
All other articles of merchandise	66,034	3,74,418
Total	2,63,794	15,86,585

Cost calculated for 12 *months ended June*, 1883.

	Rs.
Control	1,65,200
Management—	
Engineering	1,20,430
Locomotive	72,403
Carriage and Waggon ...	12,424
Traffic	78,481
Total ...	2,83,738

Returns of Traffic.

Years.	No. of Passengers.	Tons of Goods carried.
1878	888,728	117,977
1879	1,099,319	242,064
1880	1,849,790	384,214
1881	1,928,179	266,734
1882	1,917,684	263,793

General description of bridges on P. N. S. Ry.

The general direction of the Punjab Northern State Railway being, like that of the Sind, Punjab and Delhi Railway between Delhi and Lahore, at right angles to the rivers, it was necessary to build several very large bridges. The first three rivers crossed—the Ravi, Chenab and Jhelum—are very similar to the three bridged by the Sind, Punjab and Delhi Railway, *viz.*, the Jumna, Sutlej and Beas, though the difficulties met with owing to the varying channels of the rivers are not quite so great perhaps as in the case of the two last named. Still we see at the site of each the same conditions, a fairly permanent high bank on the right, and on the left a low one subject to inundation and erosion. All these

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General description of bridges on P. N. S. Ry.

illustrate the law by which, owing to the rotation of the earth, rivers running north and south are constantly working their beds in a westerly direction, the tendency increasing as lower latitudes are reached. At Attock alone, where the Indus flows between hills, is there a bridge which can be said to rest on permanent foundations.

Principles on which designed.

The engineers who designed the bridges for the Ravi, Chenab and Jhelum had the advantage of seeing what had been done already in the way of bridging the rivers of the Punjab; they did not, however, depart very widely from the methods adopted on the Sind, Punjab and Delhi Railway. The principal novelty introduced was the founding of the brick piers to support the girders on three wells sunk side by side instead of on one only and sinking them to a greater depth, *viz.*, 70 feet in the case of the Chenab bridge, instead of only 40 feet, as on the Sind, Punjab and Delhi Railway bridges. This was of course much more expensive as far as concerned each pier, but it allowed of the use of heavier girders, larger spans, and consequently fewer piers.

Alexandra Bridge across the Chenab.

The design for the Alexandra bridge by which the railway crosses the Chenab river was approved of in 1871, and was for a lattice girder bridge with the line of rails between the girders. There were to be 64 spans, measuring 142 feet, between the centres of the piers. This makes the total length of the bridge 9,080 feet, which exceeds that of any other bridge yet built in India. Each pier is founded upon three wells in a row, each well being 12 feet 6 inches in diameter and sunk 70 feet into the bed of the river. The bridge was designed for a narrow gauge line.

Operations begun.

The actual works were first begun in the cold weather of 1870-71, but were limited to training the river directly on to the site of the bridge, as the span was as yet undecided. During the following working season materials were collected and the work of sinking the wells for the piers begun; the training works were also brought to completion. No less than 138 wells out of a total of 195 in the piers and abutments were taken in hand. By April, 1874, the whole of these wells were sunk to their full depth, and all but 15 of the piers were built up to their full height. The iron girders were in course of being delivered. During the rains of 1874 there was a heavy flood in the month of September, and the upstream and centre wells of piers Nos. 46, 47 and 48 fell. It was of course impossible to rebuild the fallen wells on the old site, so during the cold weather of 1874-75 they were replaced by others placed a little to one side, increasing two spans to 154 feet. During this season rapid progress was made.

Bridge altered for broad gauge.

In July, 1874, orders were finally given by Government that the Punjab Northern was to be a broad gauge railway. The bridges had all been designed to carry metre gauge trains only, so that it was necessary to alter the girders to make them strong enough for the heavier rolling stock. The main girders had to be put wider apart to allow for the increased gauge; the cross girders were

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lengthened, and a great deal of strengthening was required. All this work had to be done on the spot, and caused a great deal of trouble and delay. Even now that they have been altered it is not considered safe for the heaviest locomotives to cross these bridges, and they have to the experienced eye a patch-work appearance.

Operations completed.

By March 31st, 1875, however, only 15 pairs of girders remained to be erected to complete the bridge for light broad gauge traffic. In May the new piers were got down to their full depth, and were finished in October. By December all the girders were in their places, and on the 23rd the first train passed. Since the beginning of the works on the bridge, the general course of the river had become more favourable, and the training works stood well. On the 23rd January, 1876, the bridge was formally opened by the Prince of Wales, who drove the last rivet.

Stone protection for the Piers.

For the protection of the piers from scour great quantities of stone had been placed round them in the river bed. By the 31st March, 1876, nearly three million cubic feet of stone had been thrown into the river, and 48,000 cubic feet more was in reserve. It was intended to place 30,000 cubic feet round each pier, but some had absorbed as much as 45,000. The training works were uninjured by the floods of 1876. During the following year 808,000 cubic feet of stone was deposited. It was proposed to make the training works of the river permanent, but this has not been done on account of the expense.

Final completion and total cost.

Although the bridge had been altered for the broad gauge, yet the narrow gauge trains were still running by the side of the Grand Trunk Road whilst the new railway on a separate embankment was being constructed from Lahore to Wazirabad, and the metre gauge line only was as yet carried over the bridge. The longitudinal girders were in process of being strengthened, but it was not till the 6th October, 1878, that the broad gauge was actually started.

The expenditure up to March 31st, 1877, was as under, *viz.* :—

On the Bridge	Rs.	43,14,721
On Training Works	„	4,41,910
Total Rs. ...		47,56,631

Subsequent shortening of the bridge.

It was found after the completion of this bridge that the amount of waterway provided was excessive, or, in other words, that it was too long. It might be thought that this could not possibly be a defect, but it is a very serious one in the case of the Punjab rivers. If the right width for the escape of the highest floods is allowed a fairly even bed is obtained, but if too much is given the river infallibly will resolve itself into channels, forming perhaps a large island in one place and scouring out the piers in another. This was found to be the case with the Alexandra bridge, where the amount of waterway required was over-estimated. To rectify this mistake the bridge has been shortened and the river

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directed more towards the centre of the bridge by means of spurs. Six spans next the right bank have been banked up and the girders altogether removed from three of them in 1880, whilst at the other end the effect of the spurs has been to silt up ten spans permanently, and these girders also will be available for use elsewhere.

The Ravi Bridge.

The Ravi and Jhelum bridges are exactly similar except as to the number of spans; they differ from the Alexandra bridge in having smaller spans, and in carrying the line of rails on the top of the girders instead of between them. The Ravi bridge has 33 spans, which are 90 feet in the clear, or 97½ feet from centre to centre of the piers. The rails are carried on the top of the lattice girders, and below is a subway for foot passengers. The piers are founded on three wells, each 12 feet 6 inches in diameter.

History of the work.

The Ravi in the manner of its floods is the mildest of all the Punjab rivers; it is the only one on which it is possible to maintain the bridge of boats for the Grand Trunk Road throughout the year. Some slight training works were thought necessary for the protection of the banks, especially to keep the floods out of a back channel on the east side of the river. These works were begun during the cold weather of 1870-71. The wells for the pier foundations were started during the next season, when the design had been settled and the collection of bricks and other materials commenced. During the following cold weather, that of 1872-73, the whole of the piers and abutments were well advanced, and the training works at the back channel were still going on. By the end of March, 1874, all the wells had been sunk, 84 per cent. of the masonry in the piers and abutments was completed, the staging for the erection of eight pairs of girders was ready, and the training works were finished.

Opened for narrow gauge traffic.

Like the other bridges on this railway, that over the Ravi was designed for the metre gauge. The final orders for the adoption of the broad gauge were issued by Government in July, 1874; the change could not, however, be effected at once. By the 31st March, 1875, all the girders were in their places, and the bridge was completed and tested. On the 12th April, 1875, the temporary narrow gauge line was opened from Lahore to Wazirabad, including the bridge over the Ravi. The training works which had successfully resisted the attacks of the flood season of 1874 were more severely tried in 1875 and at last breached; the damage done was all made good before the next rainy season, and since then no damage of any consequence has been done. As at all the other bridges, vast quantities of stone were deposited in the bed of the river round the piers to prevent the sand from being scoured away round them. Up to the 31st March, 1876, 934,653 cubic feet of block protection had been placed, and during 1876 over 100,000 cubic feet was added to this quantity.

Change to broad gauge.

When the orders for the adoption of the broad gauge were given, it was found necessary to strengthen all the bridges. It took

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Punjab Northern State Railway.

Change to broad gauge.

a considerable time to do this, and the work was in progress during 1875 and 1876. The bridge was ready some time before the rest of the railway, for which a separate embankment was being made from the Ravi to Wazirabad instead of following the Grand Trunk Road as the metre gauge line had done. Two tracks were laid, one for the narrow gauge passenger trains and one for broad gauge trains carrying materials for the new line. The first broad gauge passenger trains started running on the 6th October, 1878; the metre gauge line was then abandoned and taken up.

Cost of the bridge.

The amount expended on this bridge up to the 31st March, 1877, was as follows :—

Cost of Bridge	...	Rs. 14,42,364
" Training Works	... "	1,50,472
Total Rs.	...	15,92,836

Something has since been added to this amount for stone protection to replace that lost by gradual absorption into the bed of the river.

The Jhelum Bridge.

The Jhelum bridge is 50 spans long, each being 90 feet in the clear, or 97½ feet from centre to centre of the piers. There are lattice girders on the top of which the rails run, and below is a subway for foot passengers.

Operations begun.

Whilst the design was being discussed in the year 1870, training works on the river above the site of the bridge were begun after the subsidence of the annual floods. During the cold season of 1871-72, the design having been finally settled, well sinking was begun and materials prepared. During the rains of 1872 the training works which had been constructed were destroyed. Before the floods of 1873 the wells of 23 piers and the abutments had made good progress, and the damaged training works were partly re-constructed. By the end of March, 1874, the wells of 27 piers were sunk to the full depth, and the masonry superstructure of 21 was completed; the abutments were ready and the girders were being delivered at the site of the bridge. In July of this year it was decided that the bridge was to be for the 5-foot 6-inch and not the metre gauge.

By the 31st March, 1875, all the wells were sunk and the piers finished, and ample protection given to them by boulders heaped round to check the scour. The girders had all been brought to the site, but some doubt having been cast on the quality of the iron work in them, their erection was suspended till they had been carefully examined and tested, as they would have to bear heavier loads than those for which they were designed originally owing to the change of gauge. These suspicions, however, were ascertained to be unfounded, and the work was allowed to proceed.

Operations completed.

The work once started proceeded rapidly, and by the following April the whole 50 spans were in their places on the piers. They

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Operations completed.

were being strengthened and rivetted up to suit them for the heavier gauge, and this was in active progress. Up to this date (April 1st, 1876) the training works had stood well; 667,000 cubic feet of stone protection had been deposited round the piers. Boulders were used for this purpose, brought from the Rhatian hills near Jhelum. On August 1st, 1876, material trains crossed the bridge for the first time, and it was opened for public traffic on the 14th September.

Metre gauge traffic at first.

Although the bridge had been strengthened for the broad gauge, yet the traffic was carried over it on the narrow gauge for two years whilst the new broad gauge line was being constructed from Lahore to Wazirabad. In the meantime some further alterations were made to the bridge in order to stiffen the floor of it. The line from Lahore to Jhelum, including the three large bridges, was opened for the broad gauge traffic on the 6th October, 1878.

Cost of the bridge.

The expenditure on the works to the end of the financial year 1876-77 was as follows:—

On the Bridge	Rs.	15,40,000
" Training Works	"	62,746
Total Rs. ...		16,02,746

The Attock Bridge over the Indus.

From the earliest historic times, from the invasion of Alexander, the Indus has always been the frontier of India. Rising in unknown regions on the northern slopes of the Himalayas, it flows first in a westerly direction, then turning southwards it threads its way through mountain defiles till it emerges from the hills at the mouth of the Pesháwar valley. Here after being joined by the Kabul river it enters a narrow gorge between high rugged hills, at the entrance to which on the left bank stands the old fort of Attock.

Almost every western invader from Alexander to Nadir Shah, leaving Afghánistán by the Khyber pass, has followed the Kabul river to its junction with the Indus; there, finding himself in a *cul de sac*, he has had to cross the great river at Attock.

Selection of site.

Like other invaders, but marching in the opposite direction, the railway engineer early looked to Attock for a site for his crossing, but he had been anticipated in some degree by his brother of the road, and long before the whistle of an engine had been heard in the Punjab a tunnel was driven right under the bed of the Indus at Attock through the solid rock. This tunnel was finished in 1862, but it was only an experimental drift, for the cost of the necessary approaches made it inadvisable to complete it to its full section. When the prolongation of the railway from Ráwalpindi to Pesháwar was decided on, it was at first proposed to make a railway tunnel of this subway; it was, however, found that the approaches to it would be very costly and that a bridge would be preferable.

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Selection of site.

During the cold weather of 1878-79 survey parties were sent out to examine the banks of the river for the best site for the bridge. The selection was somewhat limited owing to the difficulties of the approach through the hills on either side. The place eventually determined on is about two miles below Attock, where the river runs deep and rapid, but where a rock in midstream simplified the difficulties of erecting piers very much.

Design of the bridge.

The site having been fixed, the design was proceeded with. The last large bridge built in the Punjab was that over the Sutlej at Adamwahun, and as described elsewhere, it differed from the preceding ones in being constructed with very much wider spans. This plan was followed in the design of the Attock bridge, but one of the great objections to large spans, *viz.*, the enormous weight of the girders, was removed by the substitution of steel for iron. Another innovation was necessary owing to the liability of the neighbourhood of Attock to severe earthquakes which it was thought would render stone piers unsafe. It was therefore decided to make them of steel frames.

Owing to the confined nature of the gorge through which the river runs here, it cannot spread out in flood times, so that an extraordinary rise and fall had to be provided for. The form of girder adopted was one frequently used in America and called in technical language the "Whipple-Murphy truss" from its inventors. The span next the west bank is of 250 feet, the two next of 300 feet each, and then two more of 250. The two large spans cross the ordinary cold weather channel, the centre pier resting on the rock already mentioned; the other piers are on the rocks dry during the winter season. The piers are protected from trees and floating *débris* brought down in flood times by masonry cut waters built in front of them. The line is on the broad gauge. The girders are 117 feet above the ordinary level of the river. The approaches were very costly. From the east the line runs through the hills in deep cuttings and down steep gradients to the bridge; on the other side of the river it is carried parallel to the river for some distance on the steep slope of the hills, partly on high embankments and partly through tunnels under spurs of the hills.

Road Subway and Guard House.

The crossing here was considered of such importance that the Grand Trunk Road has been diverted from the site of the boat bridge at Attock to the railway bridge, across which there is a roadway for carts, elephants or artillery on the level of the bottom of the girders, whilst the trains are carried over the top of them. As the hills immediately looking down on the bridge from the far side of the Indus are the home of the Afridi, a stone guard house is built at the western end, in which a detachment of infantry is quartered.

Operations begun.

The first preparations for commencing work were made in the cold weather of 1880-81, during which quarters for the staff and workshops were built. A temporary bridge of boats was made at Attock, on which rails were laid to facilitate getting materials across

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Operations begun.

the river. The early part of 1881 was devoted to the preparation of material for the bridge. Quarries were opened in the adjacent hills and stone brought to the site. In May the east abutment was begun; owing to the failure of a contractor that on the other side was delayed and not begun till December. By February, 1882, the east abutment was up as far as the bed stones of the girders and the other one to the same height by May. The rock in the stream was to be built up above water level and holes cut in it for the feet of the standards of the piers. This was found to be no easy matter, as the rock was honeycombed with water-worn caves, which had to be filled up with concrete. By the end of February, however, the foundations of this pier (No. 3) were made secure, and by the 1st April two tiers of the steel standards and streets were in their places. The remaining piers were to rest on the rocky shores; it was thought unsafe to shake the rock by blasting, so the holes for the feet of the standards were cut out by hand with hammer and chisel. The whole of the piers were finished by July. A sudden flood on the 21st of March rising 7 feet delayed the works till the 12th April, when the river went down to its usual level.

Erection of girders.

The building up of the timber staging for the erection of the girders was begun in March, and the actual erection of the girders themselves in the following June. By the end of the month one span was in its place and the girders of the next one being put up. These were the two eastern spans; they were completed by the end of September. The timber staging was then removed to the other side for the construction of the shore bay on the left bank. During the flood season of 1882 the staging for the two large spans over the deep channel was prepared. Owing to the depth of the water, the velocity of the current, and the rocky bottom, it was impossible to build up the staging in the ordinary manner, but it had to spring from the feet of the piers on either side and to bridge the gap without any intermediate support. This was successfully achieved by a system of very ingenious framing, and by the beginning of the year 1883 the staging was ready and the erection of the girders began. In the meantime the most easterly bay had been worked at, and the girders were got into position in December, 1882. The work on the large girders was pushed quickly forward, so that they were finished by the end of March, 1883. During the preceding year the heavy work on the abutments and wing walls had been in progress, and they were finished by March except the coping. The whole of the rivetting on the bridge was completed in April, and on the 5th May the first engine crossed the bridge. The testing was done on the 12th and 13th May, and the formal opening took place on the 24th, the Queen's Birthday. Owing to one of the tunnels on the western approach not being quite ready, the actual opening for traffic was delayed a few days and took place on the 1st June, 1883, when the first train from Peshāwar crossed the bridge with through carriages for Calcutta.

Bridge opened for traffic.

Cost.

The Attock bridge, though short compared with the other large Punjab bridges, was costly, owing chiefly to the large spans of the

girders. The total amount expended on it was Rs. 31,50,000. One item which generally figures largely without there being very much to show for it, *viz.*, training works, is conspicuously absent in this instance.

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North-Western State Railway.

SECTION B.—NORTH-WESTERN STATE RAILWAY.*

The Sind Railway.

At Lahore are situated the head offices in India of the Sind, Punjab and Delhi Railway, one of those lines constructed by a public Company with a Government guarantee of 5 per cent. on the capital expended. The history of this important undertaking dates back to the year 1855, when on the 26th December the first contract was signed between the Board of Directors of the Sind Railway Company and the East India Company. The original scheme was to construct a railway from the port of Kurrachee to a point opposite Hyderabad on the Indus, with the object of intercepting there the trade coming down the river and avoiding the tedious and dangerous journey round the Delta. Accordingly the line was constructed and opened to Kotri, on the bank of the river and 105 miles distant from Kurrachee, on 13th May, 1861.

The Steam Flotilla established.

In the meantime, in 1857, an Act of Parliament was obtained authorizing an enlargement of the scheme by the raising of more capital for two connected undertakings, the shares in which were, however, to be kept distinct. The first of these was the establishment of a steam flotilla between Mooltan and Kotri; the second the construction of a railway from Mooltan to Lahore and Amritsar, the whole to work in direct connection, but the accounts to be kept separately. An agreement between the Railway Company and the Government of India to regulate the establishment and working of the proposed flotilla was signed on the 7th February, 1859, and another relating to the new railway on the 4th March in the same year.

The Punjab Railway.

The Delhi Railway.

In 1863 it was proposed to extend the line from Lahore and Amritsar to Delhi, the extension being called the Delhi Railway. The Government of India agreed to guarantee interest on the capital required for the whole of these works at the rate of 5 per cent.

Amalgamation.

The operations of the flotilla were begun in January, 1862; the line from Mooltan to Lahore was opened on 24th April, 1865, and through to Delhi in May, 1870. There were now four undertakings, *viz.*, the Sind Railway, the Indus Steam Flotilla, the Punjab Railway and the Delhi Railway, with a common management, but separate shares and accounts. In 1869 a bill was passed in Parliament

* The North-Western State Railway now includes, besides the lines worked by the Sind, Punjab and Delhi Railway, (1) the Punjab Northern State Railway already described; (2) the Sind Sagar Section (Multan to Mahmudkot and thence to Kundian—see foot note to page 233); (3) the Indus Valley State Railway; and (4) the Kandahar State Railway, *i.e.*, the Railway from Ruk to Sibi and its extensions to Quetta and Pishin.

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North-Western State Railway.

called the "Sind Railway Company's Amalgamation Act, 1869," under which the several ventures were merged into one. This necessitated a new covenant with the Government of India, which was entered into in the following year, and the present "Sind, Punjab and Delhi Railway Company" dates its existence from the 1st July, 1870.

Contract between Government and the Company.

The land required for the construction of the line was given free on a lease for 99 years by the State, at the expiration of which the railway and everything connected with it was to become the property of the Government of India, the period of the lease dating from 1st January, 1860. The new covenant gave Government the power to buy the railway at the end of 25 or 50 years from the date of the commencement of the lease, paying to the Company the average value of its stock in the market during the three years prior to the date of sale. The first period will expire on the 31st December, 1884.* The original guarantee of 5 per cent. interest on the capital expended was continued. In the case of more recent lines it has been provided that surplus profits over and above 5 per cent. are to be shared by Government and the Company until all arrears of interest made good by Government shall have been repaid, after which the Company is to get the full benefit. The Sind, Punjab and Delhi Railway Company, however, agreed to share surplus profits with Government without any restriction, a concession which as yet has not cost much.

Sind Section and Indus Flotilla.

It will not be necessary to allude further to the Sind section of the railway. The steam flotilla worked with great success, and carried a large amount of traffic in goods between Sher Shah, the port of Mooltan and Kotri, besides what was picked up *en route*. The bulk of the merchandise was carried in lighters made fast alongside the steamers, which went rapidly down the river, often very much at the mercy of the stream. The journey to Kotri with a due allowance for time spent in getting off the many sand banks might be done in from 6 to 12 days. The upward voyage was a very different affair, and might safely be calculated to last three weeks. The construction of the Indus Valley State Railway, bridging the railway gap between Mooltan and Kotri, with the one exception of the Indus crossing at Sukkur, was a deathblow to the financial prospects of the flotilla, which finally ceased running in 1878, and the fine fleet of steamers and lighters was broken up and sold.

Punjab Section described.

The original "Punjab" line, *viz.*, that from Mooltan to Lahore 208 miles in length, was opened on the 24th April, 1865, or three years later than the short line from Amritsar to Lahore. For the most part of it the line passes through a desert midway between the Ravi and Sutlej, where water is only found at a depth of some ninety feet below the surface. This waterless level country has the advantage of being very easy to make railways in ; there are no bridges, cuttings or embankments, and the line has an absolutely straight length

* On the expiration of the period the Government purchased the line, which is now worked under the name of the North-Western State Railway.

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Punjab Section described.

of 180 miles. Chichawatni, Okara, Raewind and Montgomery are the only intermediate stations of any importance, the first being the point of departure for the mail cart road to Jhung and Dera Ismail Khan. Okara does a large traffic with Fazilka on the Sutlej, the principal depôt of the oil seed trade. Raewind is the junction with the branch line to the Sutlej opposite Ferozepore. Montgomery, the half-way station, is the head-quarters of the district of the same name. The country is more fertile as Lahore is approached owing to its being irrigated by the Bári Doáb Canal. Great quantities of wheat have been exported from these districts during the last two or three years.

Delhi Section described.

As has been said already, the 32 miles of line between Amritsar and Lahore were opened in 1862, but the rest of the "Delhi Railway," *i.e.*, from Amritsar to Ghaziabad, the point of junction with the East Indian Railway running into Delhi itself, was not completed without many difficulties and delays. Early in 1864 a beginning was made, and the work was given out in various contracts; but in May of the following year Messrs. Brassey & Co., the celebrated Contractors, undertook the construction of the whole line in five years, Mr. Charles Henfrey being the Engineer Superintending. Hitherto the work had been easy, the country was level, rivers and floods nowhere. Between Amritsar and Delhi the land was indeed level still, but intersected by the great rivers Beas, Sutlej and Jumna, to say nothing of lesser ones whose beds, sandy wastes for 51 weeks of the year, might be torrents half a mile wide the remaining week. The bridging of rivers like these was a novelty to the English railway engineer accustomed to streams of conservative principles which had flowed in the same bed since pre-historic times. A Punjab river is always eating its way into the land on one side or the other and so shifting its channel, thus tending to leave bridges thrown over it high and dry and necessitating a new one elsewhere. The history of these bridges will be found below; it need only be said here that the line was opened out from both ends towards the Sutlej bridge. The completion of this great work caused an extra year to be added to the term of the contract, and delayed an earlier completion of the line.

The dates of opening the various Sections.

The first portion to be opened was from Ghaziabad to Meerut, 27½ miles, in April, 1867; the next from Amritsar to the bank of the Beas, 26 miles, in November of the same year. The next sections included some large bridges. From Meerut to Umballa 121 miles was opened on the 1st January, 1869, and thence 71 miles more to Ludhiána on the bank of the Sutlej in October, 1869. The line from Jullundur to Beas, a distance of 26 miles, including the bridge over that river, was completed in November of that year and 24 miles from Phillour to Jullundur in the following April. There now remained only the bridge over the Sutlej, lying between Ludhiána and Phillour. This was completed on the 15th October, 1870, and through communication by railway opened from Mooltan to Calcutta and Bombay.

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The dates of opening the various Sections.

In times of heavy rain the Punjab rivers overflow their banks, floods come down from the hills, and the rain which falls runs over the face of the country instead of escaping into the rivers. To prevent the line of railway being washed away bodily many miles of viaduct have to be provided, and this precaution is not always sufficient. Three miles east of the main river is the Beas valley, where in 1878 six bridges were washed away. The principal torrent beds bridged are those of the Gugger, Tangri and Markunda, all near Umballa. The section of the line east of the Jumna, 112 miles in length, is beyond the limits of the Punjab. Originally it had been determined to reach Umballa from Delhi by following the Grand Trunk Road through Paniput and Karnal; it was considered necessary, however, for military reasons that Meerut should be on the line, and that Saharanpur should also be included, if only for the great pilgrim traffic to Hardwar. No doubt a chord line lying within the Punjab will eventually be made.

Gauge of the Railway, Permanent Way, &c.

The whole of the Sind, Punjab and Delhi Railway has been constructed on the broad or 5′ 6″ gauge. The line is a single one, with the exception of a very short length at Kurrachee, and the earthwork is for a single line only; also the bridge foundations and superstructure; twenty-six miles of embankment from Amritsar to Beas are for a double line. The rails used originally were of iron; these were replaced by others with a steel head, which proved a complete failure, and rails of solid steel, weighing 68℔s. to the yard, are now laid instead of them. The greater portion of the line is laid on deodar sleepers and the remainder on iron bowl sleepers. The deodar has been found very durable and many of the original sleepers are still in the line; there is little doubt, however, that eventually nothing but iron will be used.

Damages by floods.

From 1870 to 1883 there were no further extensions of the system; the rainy season, however, generally provided occupation for the engineering staff. During 1871 and 1872 considerable damage was done by floods to the line in the neighbourhood of the Beas and Sutlej and elsewhere, and through communication was interrupted for some time. The section between Amritsar and Jullundur also suffered severely during the floods of 1875. From August, 1876, through communication was stopped till December in the same year owing to damages to the Sutlej bridge, and again in 1878 from August till October owing to flood damages.

Recent extensions of the System.

Sirhind Canal Railway.

During the construction of the Sirhind Canal a railway had been laid down from Doraha Station on the Sind, Punjab and Delhi Railway to Rupar, a distance of 34 miles, where the head works of the canal and weir across the Sutlej are situated, and from Rupar 14 miles further to the stone quarries at Nálagarh. When the canal was finished this line was no longer required by the Irrigation Department, and accordingly it was made over experimentally to the Sind, Punjab and Delhi Railway to work for a year to ascertain

whether it would pay to work for public traffic. The line was opened on the 1st April, 1883, and the traffic to the town of Rupar, a place of 10,000 inhabitants, has been good. The railway runs mostly along the canal bank and crosses two large hill torrents between Rupar and Doraha, which are taken over the canal by "superpassages." During the rains of 1883 these torrents caused constant interruptions to the traffic owing to the sand of their beds burying the rails; a still more troublesome stream between Rupar and Nálagarh necessitated the closing of that section, and it was not thought worth while to reopen it to the public after the rains owing to the smallness of the traffic.

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Recent extensions of the system.

Sirhind Canal Railway.

Raewind Branch.

For some years it had been proposed to run a branch westwards from the line between Lahore and Mooltan to a point on the banks of the Sutlej opposite the important town and arsenal of Ferozepore, which is the centre of a great grain-producing district. This project, having been approved by the Board of Directors, received the sanction of the Government of India in November, 1882, and in April following a branch from Raewind on the main line to the town of Kasur, 16 miles distant, was opened. A further portion, 7 miles in length, opened on the 10th June, 1883, carried the railway to the right bank of the Sutlej at Gandasinghwala within 10 miles of Ferozepore. This short branch of 23 miles was opened at a timely moment and reaped the full benefit of the unprecedented traffic in grain of the year 1883. Though opened such a short time its receipts equalled those of any similar length of the main line. After the rainy season of 1883 the branch was prolonged across an island in the river, and a temporary station opened on the 16th December in the middle of the bed of the Sutlej at the head of the bridge of boats.*

The addition of the Raewind and Rupar branches brought the total mileage of the railway to 739. Great activity had meanwhile been displayed at Kurrachee, but it falls beyond the scope of this description. The effect of the works in progress at what is really the port of the Punjab will, it is hoped, be highly advantageous to the trade of the Province.

Head-quarters at Lahore.

The head offices of the railway are situated at Lahore, where there are also extensive workshops employing over 2,000 men, and in which not only all the rolling stock used on the Sind, Punjab and Delhi Railway, excepting the Sind section, has been erected, but also a vast quantity for the State Railways.

Growth of Traffic.

The policy adopted during the last few years has been to give every possible encouragement to traffic, both of passengers and goods, by reducing rates and fares and increasing the number of

* The Sutlej has since been bridged, and the branch line has been carried into Ferozepore to meet the Rewari branch of the Rajputana-Malwa Railway.

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Growth of Traffic.

stations, and improving the train service and accommodation generally; and there is little doubt that further steps in the same direction will produce satisfactory results. Since the opening of the line there has been a steady growth of traffic. The famine of 1877 in Southern India gave a great impetus to the grain export from the Punjab, and the consequent increase of traffic on the Railway has been maintained in subsequent years. In 1880, owing to the Afghan War and the great number of troops carried over the line, the Company earned 5·24 per cent on its capital, and for the first time there was a surplus over and above the Government guarantee of 5 per cent. The earnings were less in 1881 and 1882, though the receipts per mile of line open were greatly in excess of those of any years previous to 1877. The past year 1883 has witnessed a remarkable development of the export to Europe of wheat and oil seeds from the Punjab, and the earnings have been exceeded in the year 1877 alone. There is every reason to hope that the present state of prosperity is a healthy and lasting one, due neither to wars nor to disastrous famines in other parts of the empire.

Cost of the Railway.

The total length of line constructed to the 31st December 1882 was 663½ miles, at a cost, exclusive of steam boats for the Flotilla, of Rs. 11,21,50,810. This includes all rolling stock, station buildings, workshops, &c., and comprises the whole of the actual Railway in the Punjab and Sind, and gives a cost per mile of Rs. 1,69,029. The traffic statistics are given for a total mileage of 676 miles, which includes the distance from Ghaziabad worked over but not constructed by the Sind, Punjab and Delhi Railway.

Statistics.

The accompanying tables give the most interesting facts regarding the working of the line; in all cases the figures include the Sind section, which cannot be separated from the rest :—

General Results of Working.

Items.		1878	1879	1880	1881	1882
Mean length open		Miles. 663	Miles. 663	Miles. 663	Miles. 676	Miles. 676
Earnings		Rs	Rs.	Rs.	Rs.	Rs.
	Coaching ...	30,77,570	38,76,099	43,83,619	36,43,784	36,01,112
	Goods	46,53,186	63,83,378	67,34,266	56 94,210	57,78,038
	Steam Boat ...	8,48,436	4,48,861	2,43,930	1,53,303	16,569
	Sundries	3,51,023	7,06,337	10,49,703	6,82,850	6,36,605
Total ...		89,30,215	1,14,14,676	1,24,11,518	1,01,74,147	1,00,32,324
Working Expenses		57,60,124	68,74,155	69,40,656	70,97,487	66,21,444
Net Earnings		31,70,091	45,40,520	54,70,862	30,76,660	34,10,880
Capital expended on open line, including Steam Boat ...		11,09,81,062	11,37,04,800	11,52,29,919	11,61,01,033	11,60,15,535
Per cent of profit on capital expenditure ...		2 86	3·99	4·75	2 65	2·94
Average gross earnings per mile per week ...		230	312	353	285	285
Percentage of expenses on earnings ...		64 50	60·22	55 92	69·76	66·00

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Statistics.

Quantities of the Principal Commodities carried and the Receipts therefrom.

Description of Commodity.	Quantity.		Receipts.	
	1881.	1882.	1881.	1882.
	Tons.	Tons.	Rs.	Rs.
Animals, living (sale) ...	5,291	2,764	23,723	14,138
Borax	372	485	4,363	4,838
Canes and Rattans	811	815	5,334	4,836
Caoutchouc	10	12	82	98
Chinese and Japanese Ware ...	49	52	1,130	1,135
Coal and Coke	70,632	62,323	3,78,637	3,05,318
Cotton, raw	7,359	13,324	97,473	1,26,009
Cotton, manufactured ...	21,037	21,155	3,36,498	3,31,735
Drugs and Medicines	5,053	5,087	69,736	66,284
Dyeing Material	5,937	5,551	87,411	79,172
Earthenware and Porcelain ...	277	345	6,507	6,513
Fibrous Products	6,762	9,687	47,283	66,616
Fruits and Nuts	15,179	14,364	1,90,125	1,68,991
Grain and Pulses	223,629	336,855	13,15,437	17,48,358
Gums and Resins	508	498	6,154	5,578
Hides and Skins	5,780	4,885	52,931	46,628
Horns	244	229	2,091	2,473
Lac	527	341	8,286	4,665
Leather	1,122	1,183	20,747	20,597
Liquors	8,206	7,813	1,07,900	92,526
Mats	136	188	1,343	1,528
Metals and manufactures of ...	21,892	22,439	2,11,703	2,21,656
Oils	3,227	3,293	42,795	44,960
Opium	38	21	702	687
Paints and Colors	363	450	6,540	7,694
Provisions	9,350	9,015	99,929	77,609
Salt	37,387	46,299	1,69,072	1,92,3[illegible]6
Saltpetre, &c.	911	1,129	7,927	10,844
Seeds	26,539	58,109	1,45,713	3,29,033
Silk	370	448	6,749	8,982
Spices	4,169	4,246	48,337	46,607
Stone and Marble	4,566	15,568	33,170	43,999
Sugar	70,504	79,383	6,25,031	5,88,992
Tea	2,420	1,934	37,308	30,909
Tobacco	1,663	1,751	22,660	24,435
Wood	34,439	37,585	1,11,496	1,05,888
Wool	10,006	9,602	1,30,175	1,16,168
All other articles, merchandize ...	15,975	13,773	2,22,458	2,15,425
Bark (tanning)	...	...	...	...
Coffee	...	...	...	...
Government Stores	9,457	8,333	138,616	1,36,155
Manures	...	...	...	...
Vegetables	...	...	...	...
Chunam and Lime	...	...	...	...
Hay and Straw and Grass, &c. ...	...	...	...	...
Oil cake	91	199	447	665
Kunkur	13,697	18,059	13,080	18,424
Lime and Bricks	5,545	7,875	21,417	34,096
Railway materials, Sindh, Punjab and Delhi Railway—Capital ...	13,577	25,008	21,270	30,354
Revenue	323,383	128,795	296,336	1,85,092
Railway Materials, Foreign ...	62,330	28,988	4,75,751	1,34,287
Total ...	1,050,822	1,010,259	56,50,937	57,56,259

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Statistics.

Cost calculated for 12 *months ended June* 1883.

	Rs.
Control	4,60,850
Management—	
Engineering	2,53,382
Locomotive	1,48,099
Carriage and Wagon ...	21,100
Traffic	1,38,374
Total ...	5,60,955

Traffic Returns.

Year.	No. of Passengers.	Tons of Goods.
1878	3,074,515	1,052,549
1879	3,588,878	1,518,041
1880	4,160,123	1,256,675
1881	4.102,153	1,134,483
1882	4,228,921	1,128,599

The Sutlej Bridge at Phillour.

The most important engineering work which had to be undertaken in the construction of the Railway between Lahore and Delhi was a bridge over the river Sutlej. The Beas and Jumna had also to be bridged, but they were not so wide and had not such an evil reputation; the Sutlej, on account of its ever-shifting channel and shoals and general vagaries, is a bye-word amongst the natives of the Punjab. Besides this no work similar to and of such magnitude as the bridging of these rivers had ever been undertaken in India at that time or indeed anywhere else. It was not that equally lengthy bridges had never been made, but the problem of how to carry a railway bridge a mile or more in length on piers founded in unstable sands, had added to it as a rider, how, having built the bridge, was the river to be kept running under it.

Location of line.

The question of the location to be adopted for the new railway was dependent, not only on the situations of the large towns which might be passed through, but also on the finding of practicable sites for the bridges. The first surveys were made in 1856, but it was not till 1864 that it was finally decided to cross the Beas and Sutlej above their point of junction, and that the bridge over the latter should be situated at Phillour where it would be under the guns of the fort.

History of the work.

The construction of the bridges was undertaken by the now famous firm of Brassey, Wyther, and Henfrey, who had been given a contract for the whole line, and a short sketch of their building of the bridge over the Sutlej and their various failures and difficulties will not be without interest as illustrating a phase of engineering peculiar to India and the perseverance which finally surmounted all obstacles. The construction of the other bridges in this line over the Jumna and Beas was attended with much the same difficulties though in a lesser degree, especially in the case of the Jumna. The first thing to be done was to determine the channel of the river, which at Phillour is five miles wide between the permanent banks. Strictly speaking the Punjab rivers have no permanent banks; like all rivers running north and south they have a tendency to work in a westerly direction. Early in 1866 directing spurs were made above the bridge on the east bank to try and close up a large bay there was there.

Construction begun.

The original design was for a bridge of 37 spans with 99 feet of clear waterway in each, the girders resting on brick piers 111 feet 6 inches from centre to centre. The construction of these piers was begun in March 1866, the ordinary Indian method of sinking

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Construction begun.

wells being adopted. The bed of the river consists of light sand to a depth of forty feet, beneath which is a structure of clay, and on this the piers were to rest.

The efforts to guide the river channel to the spot fixed on for the bridge were not very successful, and in the early part of 1867 it was decided to move the bridge 2,340 feet towards the west, so that the right abutment rested on the high Phillour bank. The well-sinking was continued and new spurs were made up the river to train the stream between the two abutments. Progress, though slow, was interrupted only by the rainy season, and, no accident delaying the work, by the 30th June 1868, or nearly two years and a half from the date of commencement, nearly all the piers were finished and ten of the girders were erected. By the end of 1868 21 spans were completed, and the contractors calculated that the bridge would be finished by the following October. The Sutlej, however, instead of behaving as a well-conducted river should and flowing under the bridge, was mostly running to the east of the left abutment, which, instead of being on the bank, was in mid stream. There was no help for it but to add 20 spans to the east end of the bridge, and the contractors were allowed an additional year for their completion. The bridge, as originally designed, was finished in June 1869, but it was not till the 13th June 1870 that the last girder of the new spans was raised. The whole bridge was tested in October 1870 and opened for traffic on the 15th of that month.

Completion of Bridge.

After the trains began to run across the bridge some of the piers began to settle slightly, especially during the floods of the rainy season of 1871; stone was thrown into the bed of the river round these piers in the hope of checking this tendency.

Damage by floods.

The floods of June 1872 set more towards the right bank, and scoured out the foundations of piers Nos. 16 and 17, which fell on the 9th, carrying three pairs of girders with them. The traffic was of course interrupted and had to be maintained with great inconvenience by ferry boats. It was decided to repair the breach by erecting four spans across the gap where there were originally three. Two of the new spans were finished before the rains of the following year, but as the girders for the others had not come from England, a bank of earth was filled in between the piers, and the traffic was carried over this. The repairs were completed in May 1874. Before this accident there had been 58 spans in the bridge, which then had a total length of 6,455 feet. But the fickle river having caused an addition of 20 spans to the design now came back to the right bank and left nine of them high and dry. These were accordingly filled up with earth, faced with stone and the girders were afterwards removed. All went well till the rains of 1876, when, on the 19th August, the foundations were deeply scoured and piers Nos. 48 and 49 fell and with them, as before, three spans of the bridge.

The traffic was now interrupted for a second time, a temporary station was built on the east bank and passengers ferried across. Several different plans were proposed for repairing the breach, and the one finally adopted was somewhat singular. The gaps were filled up with stone nearly to flood level with a depression in the

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Damage by floods.

centre of each span, and piers built up of clusters of four iron columns in each were erected over the site of the old piers and resting on the bank of stone. Three pairs of girders from the spans at the east end which had been banked up with earth were then moved forward and placed over the gaps. Of the fallen girders some had disappeared in the sand, and those which had not were so twisted as to be useless. The bridge was re-opened in the following December. The new piers settled a little with the weight and vibration of the trains but not to any serious extent.

The bridge shortened.

Efforts were constantly being made at a vast expense to improve the direction of the channel of the river and to throw the main stream more on the centre of the bridge, and with this object the spans at the east end were filled up as far as pier No. 46. The girders from these spans, as well as the iron piers Nos. 48 and 49, were subsequently removed as the girders were required to repair damages caused elsewhere by the floods of 1878. The bridge has had no further mishaps; great quantities of stone have been arranged round all the piers so as to prevent scour, and a constant struggle with the river is going on above the bridge to keep it from breaching the embankment to the east of the bridge.

Description of design.

The design of the Sutlej bridge was identically the same as that of the bridges over the Jumna and Beas, only it had more spans as already described; the number was increased during construction by 30, some of which were afterwards removed. The bridge carries a line of rails only on the top of the girders; it has now (1884) 47 spans, and its length is 5,193 feet. The underside of the girders is 8½ feet above the highest flood level and 16½ feet above the lowest cold weather level.

The pier foundations (except Nos. 16, 17, 18 and 22) consist each of a single well of 12½ feet outer and 6½ feet inner diameter, of brick masonry, standing on a wrought iron curb, and bonded every ten feet with iron tie rods. The wells are 111½ feet apart from centre to centre, and were sunk till they reached a bed of clay or pebbly sand at an average depth of 43½ feet below the lowest water level. The wells were filled up with concrete to the water level, and above this the piers were built. The girders, double triangulated and of wrought iron, are 110 feet long and 9 feet 0½ inch deep, each pair being calculated to carry a load of 200 tons, including the weight of the girders themselves. The rails rest on longitudinal sleepers placed immediately over the upper flange of the girders.

Cost of bridge.

The cost of the bridge to the date subsequent to the repair of the first breach was about Rs. 31,00,000, or Rs. 480 per lineal foot, and Rs. 2,54,000 was spent up to the same time on protection and training works; these may be taken roughly to cost one lakh per annum.

The Beas Bridge.

In the account of the Sutlej bridge a general description of the nature of the difficulties to be encountered has been given, which applies equally to the Beas bridge, and the reasons which led to the selection of the route finally adopted were narrated so that it will not be necessary to repeat them here. The site first selected at Wazir Bholar, near the crossing of the Grand Trunk Road, was adopted. The design for the bridge was identically the same as

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The Beas Bridge.

for that over the Sutlej, but with 29 spans only. This gave a width of 3,222½ feet between the faces of the abutments and 2,871 feet of clear waterway. The rise of the floods is from 10 to 11 feet, and this leaves a minimum headway of 9½ feet. The site is very similar to that at Phillour; on the west side is a high bank, and on the east the river is perpetually trying to get behind the abutment, and its efforts are successful. The fall is rather more rapid than that of the Sutlej, being about two feet per mile. The beds of clay in the sand are thin and at varying depths. The piers were sunk from 42 to 47 feet, mostly without entering the clay. The west abutment projects 300 feet from the high bank.

In 1864 the left bank of the river was 260 feet behind the site fixed for the last abutment, and during the floods of the following year this was increased to 720 feet.

Construction of Bridge.

The first operations of well-sinking began in February 1866. Continuous progress was made with the construction of the bridge without interruption, and it was completed in June 1869. Whilst this work was going on the contractors had been making great efforts to direct the river through the bridge by means of guiding spurs, and in January 1869 they at last succeeded in doing so, and the east abutment was connected with the shore by a long embankment protected by ten spurs.

Damage by floods.

The Beas soon began its assault on the new bridge. In the floods of 1870 the ten spurs were much damaged, and in 1871 in the month of July a very heavy flood completed their destruction. The protecting spurs gone the east abutment did not long survive them but fell, and then the approach bank was washed away till the ruins of the abutment were left in the middle of a strong stream 600 feet from the shore. In the meantime several of the piers had suffered from the excessive scour, and No. 28 fell, carrying with it two pairs of girders. The west abutment wall also suffered from settlement. This mishap was not completely made good till the end of November 1873, more than two years after. Traffic was stopped entirely till after the rains of 1871, and then a line was laid across the almost dry bed of the river. To enable the permanent repair of the broken spans to be carried on during the following rains a temporary trestle bridge of 49 spans of 25 feet each was built, and the trains ran over this through two rainy seasons and till the bridge was re-opened for traffic. The broken girders were renewed, and it was also necessary to lengthen the bridge towards the east, which was done by adding five spans of 110 feet each to replace the embankment which had been washed away. The new piers were 15 feet in diameter and were sunk to depths of from 52 to 69 feet.

Cost of Bridge.

The actual cost of the bridge to the date of its re-opening (November 1873) was Rs. 22,90,166, or about Rs. 600 per foot in length.

Protection Works.

To protect the new abutment a bank was constructed along the east shore above the bridge for a distance of 5,000 feet and faced with stone. Since 1873 no serious damage has been done to this bridge by floods, and the scouring of the sand round the piers has been

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The Jumna Bridge.

checked by placing great quantities of stone and kunker round them in crates.

The most direct line to be adopted for a railway between Delhi and Lahore would be that following the Grand Trunk Road, which, keeping on the right bank of the Jumna after leaving Delhi, passes though Karnal and Paniput, and continues almost in a straight line to Umballa. This route avoids crossing the river, but it was considered essential that Meerut should be connected by railway with Delhi, and as the East Indian Railway already had a bridge over the Jumna opposite that city, only one additional bridge had to be constructed by the S. P. D. Railway Company. Instead, therefore, of bringing a second line into Delhi a junction was made at Ghaziabad, 15 miles off in the direction of Agra.

Description of site.

The site selected for the new bridge lay in the direct line between Saharanpur and Umballa, and the Jumna at this point is so near its débouchere from the hills that the difficulties of bridging it were much less than lower down; the river had not had time to degenerate into the uncertain ways of the Punjab streams. The bed consists of boulders as far down as within six miles of Sirsáwa, the spot selected for the crossing, and even here they are found below the surface of the sand. The result of borings in the river bed showed first 18 feet of fine silt, then 10 feet of course sand and gravel, and next 12 feet of sand with bands of blue clay from 6 inches to 2 feet thick. Under this was a bed of coarse gravel and boulders, and below all yellow clay. This was a foundation much more promising than was to be found in any of the Punjab rivers proper.

Design of Bridge.

The river runs here between well-defined banks not liable to be overflowed except in the very highest floods. The design for the bridge was identical with those for the Sutlej and Beas rivers, except as regards the number of spans, and that the abutments being much more secure they could be constructed in a less expensive manner. A detailed description of the girders and piers used for the bridge over the Sutlej at Phillour is given elsewhere, so it will not be necessary to repeat it here.

The abutments were set back 250 feet from the bank on either side, which gave a width between their faces of 2,663½ feet, and a clear waterway of 2,376 feet. The number of spans is 26. Ordinary floods rise about 13 feet, which leaves a headway under the bridge of 6 feet. The wells for the piers were sunk to an average depth of 43 feet to the bottom of the well curb.

Construction.

Completion.

The contractors began work in 1863 before the rains, and on the 16th October 1868 the first engine passed over the bridge. The line between Meerut and Umballa was opened for traffic on the 1st January 1869. There was one difficulty encountered during the construction of this bridge not met with elsewhere. During the cold weather the river was liable to sudden rises of a foot owing to the temporary closing of the canals on either bank, which ordinarily drew off their water at some distance above the site of the bridge.

Protection Works.

The protection works required for the banks above the bridge were not extensive, and, though somewhat damaged by floods in 1867, they were uninjured during the three following years. Since

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Indus Valley State Railway.

Protection Works.

the date of its being opened for traffic the history of the bridge has been comparatively uneventful; the only occasion in which any material damage has been done was in August 1871. The floods then washed away the approach embankment after destroying the protective spurs, and the wing wall of the east abutment was cracked by a settlement which took place. To check the scour in future, kunkur and stone were heaped round the piers and abutments, and on the left bank two groynes were made above the bridge and their faces protected with rubble masonry.

Cost of Bridge.

Up to the end of 1874 the cost of the bridge was Rs. 13,44,600, or Rs. 500 per lineal foot, to which two lakhs of rupees must be added for the protective works.

SECTION C.—INDUS VALLEY STATE RAILWAY.

Railway substituted for Indus Flotilla.

In the description of the Sind, Punjab and Delhi Railway reference has been made to the disconnected portions of that line, one section from Kurrachee to Kotri in Sind, and the remainder from Delhi to Mooltan, being situated mainly in the Punjab, and it has been described how the communication between Mooltan and Kotri was maintained by a flotilla of steam boats and barges on the Indus and Chenab. This arrangement was only intended as a temporary measure until the construction of the Indus Valley Railway could be undertaken, to connect Kotri with Mooltan, the first surveys for which were made many years ago by the engineers of the Sind Railway Company, to whom it was then proposed to entrust the construction of the line. Eventually the Government decided to undertake the work itself.

History of the work.

The Government orders for the survey for a line of Railway were issued on the 30th October 1869, and for construction of the northern section from Mooltan to Rohri on the 8th November 1871. The orders for the construction of the southern section between Sukkur and Kotri were given on the 4th November in the following year. It had been originally intended to make the line along the east or left bank of the river throughout, bridging it at Kotri instead of Sukkur. But this was subsequently altered, chiefly as the line would not in that case have traversed British territory throughout. The line suffered from the change of policy in regard to its gauge, though not to the same extent as the Punjab Northern. It was begun as a metre gauge Railway, and the works had made considerable progress, when it was finally decided to adopt the 5 feet 6 inches gauge. Fortunately these orders where issued in time to save the great bridge over the Sutlej at Adamwahan from being designed for the narrow gauge.

Lengths of various Sections and the dates of opening them.

The different sections of the line were opened as follows :—

	Miles.
Muzaffarabad Junction to Rohri, 1st July 1878	... 273
Sukkur to Radhan, 1st October 1878	... 81
Kotri to Lakhi, 8th October 1878	... 76
Lakhi to Radhan, 27th October 1878	... 70
Total	... 500

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Indus Valley State Railway.

Kandahar Line.

What is known as the Kandahar Branch was opened from Ruk Junction to Sibi for public traffic on the 2nd May 1880, the distance being 133 miles, but it had been in use for the transport of troops for some time previously. Subsequent extensions were made from Sibi to the entrances of the Bolan Pass at Rindli, and the Nari Gorge. The former which is 16 miles long has alone been opened for public traffic; the latter will, when completed, be the line to Kandahar. As this branch lies entirely beyond Punjab limits and forms no part of the communication between the Punjab and the port of Kurrachee, it will not be necessary to refer to it further. It is, however, unavoidably included in the statistical information given.

General description.

The actual point of junction of the Indus Valley State Railway with the Punjab Section of the Sind, Punjab and Delhi Railway, is at Muzaffarabad station on the line connecting Mooltan with Shere Shah, its port on the Chenab, and seven miles distant from the former station. From here the line runs in a somewhat southerly direction to the banks of the Sutlej, 52 miles from the junction, and here the river is crossed by the "Empress Bridge" at Adamwahan, a detailed description of which will be found elsewhere. The country between Muzaffarabad and Adamwahan is for the most part a desert; nothing is to be seen but undulating hillocks of drifting sand and a few stunted tamarisk bushes. This is the only part of the Indus Valley Railway lying in the Punjab proper. The next 148 miles to near Reti are in the native state of Bahawalpur, which is semi-independent, but supervised by the Government of the Punjab. The country is nearly as barren as on the other side of the Sutlej; near the bank of the river and where there are irrigation canals fertile strips of cultivated land appear, but they soon merge into the desert, where are only the sand hills, or level plains covered with a thick incrustation of salt white as snow.

These plains are but little above the ordinary level of the water in the rivers and are peculiarly liable to extensive floods which necessitate high embankments everywhere to carry the rails out of their reach. It was even found advisable after a considerable length of line had been constructed to remove it further from the bank of the river and abandon the original location. The principal towns passed in the native state are Bahawalpur the modern capital, Khanpur, and Ahmedpur the ancient capital. The first has a population of about 20,000 and does a considerable amount of trading; Khanpur has about half the population of the capital, and is commercially flourishing.

The Sind portion of the line.

At mile 201 the line enters the limits of Sind under the Bombay Government. The Indus Valley Railway is of such vital importance to the trade of the Punjab that a brief account of the whole system may well be given, though only a portion of it is included in this province. At Rohri, 273 miles from Mooltan, the bank of the Indus is reached, and the northern section terminates.

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Indus Valley State Railway.

The Sind portion of the line.

Since the opening of the line communication with Sukkur, the northern extremity of the southern section of the line has been maintained by steam ferries. Goods wagons are carried across the river on large barges without unloading, and passengers in a steamer. The arrangements for ferrying are so excellent that during the great rush of the grain traffic to Kurrachee in 1883 as many as 400 wagons were frequently transported during the 24 hours, work being carried on day and night with the aid of the electric light. Of course empty wagons have to be crossed over in the opposite direction to prevent an accumulation at the port.

After several years' careful examination of different sites proposed for the construction of a railway bridge over the Indus at Sukkur, that passing across the island of Bukkur was selected, and the work was begun towards the close of 1883. As the main channel of the river is to be crossed in one span of more than 800 feet the bridge will be one of great magnitude, and will probably not be finished for some three or four years from the date of commencement. It is designed on what is known as the Cantilever principle; and is similar to the great bridge now being erected over the Firth of Forth.

Seventeen miles from Sukkur is Ruk, the junction with the Kandahar line, on which are the important town of Shikarpur and the Frontier Cantonment of Jacobabad. Fifty miles from Sukkur is Larkhana, round which is the only really fertile district passed through by this railway throughout its whole length. Ninety miles beyond Larkhana a long spur from the Beluchistan Range runs out and meets the Indus with high scarps along its right bank. The line is carried round these on a terrace blasted out of the vertical rock, high above the level of the river. Very heavy works were necessary at this spot, which is known as the Lakhi Pass. North of the pass lies the town of Sehwan, which is, besides Larkhana, the only town of any size on the southern section of the line. Seventy miles further on, at Kotri, the river is touched again, and the Sind Section of the Sind, Punjab and Delhi Railway is joined. Kotri is the river port of Hyderabad, the ancient capital of Sind, and still a place of some importance.

Head quarters.

When first opened the head offices of the line were at Mooltan and the workshops at Adamwahan, the latter being so situated partly for convenience in erecting the great bridge. The offices and workshops are now however both moved to Sukkur, a more central position as regards the line.*

Importance of this line to the Punjab.

The importance of the Indus Valley State Railway as an outlet for the commerce of the Punjab has already been alluded to. Till this line was opened there was no seaport nearer than Bombay or Calcutta: before the Rajputana line was opened the former port

* Since the purchase of the Sind, Punjab and Delhi Railway by Government the Indus Valley Railway has been amalgamated with that line under the title of the North-Western State Railway.

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Indus Valley State Railway.

Importance of this line to the Punjab.

was 1,370 miles from Lahore and the latter 1280; now Bombay is brought within 1,240 miles, but two transhipments are necessary from the broad to narrow gauge and *vice versâ*. Kurrachee is only 820 miles from Lahore, and is the nearest port for every railway station in the Punjab up to and including Umballa. It is also 200 miles nearer to Aden than Bombay. The oil seeds and wheat of the fertile plains of the province, the tea from the Kangra Valley, and wool from the hill states, all are carried seawards to Kurrachee. Every city in the Punjab has its granaries stored with wheat, whose owners watch keenly the slightest fluctuations of the London market and the weather reports of the United Kingdom; the instant a remunerative price is reached, endless trains of grain go down to Kurrachee, where it is shipped off to England and various Continental ports. Unfortunately, Kurrachee is still without many of the first requisites of a convenient harbour, and her merchants have not the capital necessary to provide them.

Mileage open, Capital expended, Profits earned, &c.

The mean mileage open on the Indus Valley and Kandahar Railway up to the 30th June 1883 was 659½, including seven miles of the Sind, Punjab and Delhi Railway, over which it works between Muzaffarabad Junction and Mooltan. The capital expenditure to the same date was Rs. 8,01,62,124; the cost of construction and rolling stock was, therefore, Rs. 1,22,853 per mile of line. Up to the end of 1882 the highest profit had been earned in 1880, when it amounted to 2·77 per cent on the capital. In the first half of 1883, however, 2·36 per cent. was earned, or at the rate of 4·72 per annum.

Full details of statistics of working and financial results are given in the accompanying tables, in which, as previously stated, the Kandahar line is unavoidably included.

General Results of Working.

Items.		1878	1879	1880	1881	1882
Mean length open		Miles 381	Miles. 508	Miles. 597	Miles. 660	Miles. 660
		Rs.	Rs.	Rs.	Rs.	Rs.
Earnings	Coaching	2,29,084	7,93,996	18,03,906	14,98,701	11,18,467
	Goods	3,18,543	22,01,809	40,08,327	35,41,392	34,99,326
	Steam Boat ...	18,061	81,224	1,89,723	2,06,471	2,81,505
	Sundries	6,421	2,00,511	6,60,426	2,88,596	2,13,262
Total ...		572,109	32,77,540	66,62,382	55,36,161	51,12,560
Working Expenses		7,03,550	26,60,079	47,39,983	43,57,873	35,36,447
Net Earnings		−1,31,441	6,17,459	19,22,399	11,77,288	15,76,113
Capital expended on open line including Steam Boat ...		5,13,35,647	5,70,01,762	6,92,82,608	7,44,77,194	7,84,56,114
Per cent. of profit on capital expenditure ...		0·26	1 08	2·77	1·58	2·01
Average gross earnings per mile per week ...		56	121	209	155	141
Percentage of expenses on earnings ...		122·97	81·16	71·15	78·73	69·17

Indus Valley State Railway.

Mileage open, Capital expended. Profits earned, &c.

Abstract of Principal Commodities carried during the year 1882.

Description.	Quantity in tons.	Receipt in Rupees.
Cotton, Raw	3,597	77,435
Cotton, Manufactured	9,084	1,79,444
Drugs and Medicines	1,353	27,464
Dyeing Materials	2,690	48,901
Fibrous Products	2,587	24,047
Fruits and Nuts	6,870	1,00,703
Grains and Pulses	174,631	14,49,632
Hides and Leathers	1,027	14,583
Liquors	1,380	52,031
Metals	9,805	1,49,616
Oil	1,301	26,115
Paints and Colors	115	2,406
Provisions	1,488	33,997
Salt	3,383	20,572
Seeds	33,964	3,15,964
Silk	32	1,108
Spices	999	18,515
Sugar	19,020	1,64,319
Tobacco	759	10,525
Wood	1,579	9,820
Wool	6,869	1,72,681
All other Merchandise	33,556	1,65,630
Railway Materials, Foreign Lines... ...	15,602	2,59,487
Military Stores	834	28,886
Railway Materials for Construction ...	396,211	2,30,478
Coal	9,948	61,518
Revenue Stores	77,429	92,596
Total	816,125	37,38,473

Cost calculated for 12 months ended June, 1883.

	Rs.
Control...	2,17,791
Management—	
Engineering	1,63,260
Locomotive	1,21,456
Carriage and Waggon ...	27,031
Traffic	86,512
Total ..	3,98,259

Traffic Returns.

Year.	No. of Passengers.	Tons of Goods.
1878*	241,770	30,033
1879	831,883	235,835
1880	1,364,425	516,748
1881	1,559,969	566,612
1882	1,502,816	816,125

* Line only opened for six months in 1878.

The Empress Bridge at Adamwahan.

First Surveys.

The project for closing the wide gap in the railway between Mooltan and Kotri had been under discussion for some years before the surveys, for it were at last taken in hand by the Sind, Punjab and Delhi Railway in the year 1869. In September, 1870, alternative estimates based on this survey for constructing a broad or a narrow gauge line from Mooltan to Sukkur were submitted to Government. The scheme included a crossing of the river Sutlej at the village of Adamwahan some thirty miles above the junction of that river with the united streams of the Ravi, Chenab and Jhelum. The estimates were duly considered, and sanctioned in November, 1871, except the bridge, the metre gauge being the one selected. The designing of the bridge was a work demanding much further consideration. The Sind, Punjab and Delhi Railway Cmpany had met with considerable difficulty with their bridge over

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Indus Valley State Railway.

First Surveys.

this river higher up, above the point where it is joined by the Beas, and before deciding on how the double stream was to be bridged the engineers and Government were anxious to get the benefit of the experience which the constructors of the guaranteed railway were acquiring. In 1872 a beginning was made by building quarters and commencing workshops at Adamwahan on the right bank of the river. The floods of this year were very high; some piers of the Sind, Punjab and Delhi Railway bridge at Phillour were washed away, and the site of the colony at Adamwahan was inundated and a large block of new quarters destroyed.

Design of the Bridge.

In 1873 a committee of engineers was assembled to consider the best form of bridge. They recommended the adoption of an iron girder bridge with 16 spans of 264 feet from centre to centre of the piers or 250 feet in the clear, that each pier and abutment should be founded on three wells 18 feet 9 inches in diameter sunk to a depth of 100 feet below low water level, and that each foundation should be protected by 60,000 cubic feet of stone. This gave the bridge a total length of 4,224 feet. It will be seen that in the design for this bridge, one of the last yet constructed over a Punjab river, there is a considerable departure from the earlier methods. The bridges over all but the Chenab had comparatively small spans of about 100 feet; this was increased in the case of the Alexandra bridge to 142 feet, but here we have no less than 264 feet recommended. It was being recognized that the most economical length of girder did not necessarily mean also the securest bridge, but rather that every pier founded in shifting sand was a source of weakness and danger, and that the fewer of them employed in crossing a river the less likely would the bridge be to suffer. This principle is now being carried to an extreme application in the design for the Indus bridge at Sukkur, which is to cross the branch between Rohri and the island of Bukkur in one bold span of 800 feet.

History of the Work.

Whilst the design prepared by the committee was under consideration, the work of manufacturing bricks and collecting materials was in progress. The workshops were finished, and the construction of iron curbs for the wells was begun. The construction of training works, which were likely to give considerable trouble, was taken in hand, and as the floods of 1873 were mild, they were tolerably successful.

At Adamwahan the familiar features of the Punjab rivers are easily recognized; on the right there is the high bank gradually being worn away if allowed to remain unprotected, and on the left low land for miles, formerly traversed by the channel of the river in its lateral passage from east to west. When the velocity of the water in the river is low its tendency is to become more and more sinuous, but in flood times the bends are cut off; it is extremely difficult to predict at the close of one rainy season where the main channel of the river will run during the next one. During the earlier months of 1874 operations were confined to training the river and collecting materials and plant so as to be ready to begin the bridge in the following November. In June of this year it was decided to adopt the broad gauge, fortunately in time

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Indus Valley State Railway.

History of the Work.

for the girders to be planned in accordance. The designs having been approved of, the first well curb was pitched in November, 1874. The training operations had been successful, and during the floods the main body of the stream was in the centre of the bed of the river.

For convenience in getting materials to their site in the bed of the river a temporary pile bridge 1,000 feet long was made across the cold weather channel, and over this metre gauge material trains ran from the Adamwahan side. It was opened on the 1st February, 1875. For experimental purposes six foundations only were commenced at first; they consisted each of three wells 18¾ feet in diameter, and were begun from opposite ends of the bridge; the end ones of all were to support the abutments. By the 31st March, 1875, they had been sunk from 22 to 32 feet; those at the eastern side reached tenacious clay at a depth of 26 feet. In the bed of this river brushwood and trees were found buried beneath 30 feet of sand.

The floods of 1875 were very heavy, exceeding the highest previously recorded. For the protection of the pier furthest from the east bank 100,000 cubic feet of stone were thrown in. The river overflowed the low ground on the left bank, and accumulated to a height of 3 feet 9 inches against the embankment of the approach to the bridge, and made several breaches in it. The workshops and colony at Adamwahan were again inundated and damage to the extent of Rs. 1,20,000 done. A committee was appointed to enquire into what should be done in the way of training works to prevent damage in future. The amount thus expended from January, 1874, to the end of the flood season of 1875 was Rs. 3,25,000, and the result obtained was not remarkably conspicuous. The works on the foundations and piers of the bridge were continued throughout the cold weather of 1875-76. In August, 1876, there were floods of unprecedented height; the bridge works were not damaged, but an encroachment on the left bank above the site of the bridge begun last year now assumed very threatening proportions; the river was, however, restrained from getting behind the abutment. A vast mound of stone 2,000 feet long had been prepared, and this alone saved the embankment. The directing spurs which had been made were all swept away. So after an expenditure of a great deal of money the river was in a worse position than at the beginning. When the river subsided after the floods a cut was made in the hope of bringing the main stream over towards the right bank. During the previous cold weather a high dam was made round the workshops and quarters; this was fortunate, as but for this protection the whole would have been destroyed.

In February, 1877, a sudden and unexpected rise of the river entirely destroyed the temporary pile bridge which was re-established each cold weather. The work was delayed in consequence, though no other mischief was done; the bridge was restored in ten days. One effect of this flood was the improvement of the channel of the river. The well sinking all this time was making good progress, so that by the end of April, 1877, eleven piers only remained to be finished, and in the following August the well sinking was complete. No damage

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Girders being erected.

was done by the floods this year. Work was resumed in the cold weather of 1877-78, and the superstructure of the piers was completed in February, 1878.

In the meantime the erection of the iron girders, which with such a large span was a work of considerable magnitude, was progressing. At the end of the financial year 1877-78 eleven spans were complete, the girders of two spans were being erected, those of two more were being delivered, and one pair of girders was still at Kotri. In two of the spans not yet begun the bed of the river had scoured till the water was from 46 to 58 feet deep. This of course greatly increased the difficulty of erecting the girders, and a timber staging had to be built up of spans 70 feet long. On the 13th April, thirteen spans were complete, and on 22nd May the entire bridge was finished and tested. It was formlly opened on the 8th June, 1878, by Sir Andrew Clarke and named the "Empress Bridge."

Bridge completed and opened.

The work of construction was actually begun with the pitching of the first curb in November, 1874, so that the bridge was actually completed in a little over three years and a half, which was a year less than the estimated time.

Protection for left bank.

For the protection of the left bank, in which a deep bay seriously threatening the east abutment had been formed, a long embankment with a stone facing was constructed at a heavy cost. The effect of this bund was the silting up of the bay to a great extent. Since the opening of the bridge some short spurs have been made to effect a further silting. The span of the bridge next the left bank has been filled up with stone and the silted-up bay covered with a growth of brushwood. The east abutment will, however, always be more or less of a weak point to be watched with great caution and carefully protected from the attacks of the floods.

Cost of Bridge.

The cost of the bridge itself, not including any training works, was Rs. 51,70,155. The cost of training works on the river and protection to the banks was Rs. 16,40,114 up to the date of opening, and a further expenditure of Rs. 1,25,882 has since been incurred on this account. The temporary pile bridge cost Rs. 1,98,054, so that the whole amount spent on the bridge to the 31st March, 1884, was Rs. 71,34,210.

SECTION D.—MINOR AND PROJECTED RAILWAYS.

RAJPURA-PATIALA RAILWAY.

Proposals for railway to Simla.

For many years past the question of a nearer approach by railway to Simla has been under discussion. Among the many schemes which have been proposed for connecting Kalka, where the Simla road begins to ascend the hills, with the Sind, Punjab and Delhi Railway, the only one which as yet has produced any visible result is the project of the Patiála State to construct a railway from the capital of that name to Kalka, crossing the main line at Rajpura; this line would be within the limits of the native State, and it was proposed to pay for it out of surplus revenues which had accumulated and were lying idle in the treasury. This idea was submitted to Government by the Maharajah in 1866,

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and the line was actually surveyed, but in the following year he withdrew the proposal and nothing came of it at that time.

Patiála State line from Patiála to Rájpúra.

Early in 1883, however, the project was revived by the Council of Regency of the Patiála State so far as concerned the line between Rájpúra Station on the Sind, Punjab and Delhi Railway and the city of Patiála, and Government having approved of this, a new survey was made and estimates drawn out for the construction of the line, 16 miles long, by the Sind, Punjab and Delhi Railway Company. The estimates were agreed to by the Council of Regency, and on the 14th December, 1883, the first sod was turned by the Lieutenant-Governor of the Punjab at Patiála city, and work was at once begun. As already remarked, the Patiála State pays for the construction of the line, which is estimated to cost Rs. 12,44,388, or Rs. 77,774 per mile. This does not include any rolling stock or the cost of the Junction Station at Rájpúra, which will be paid for by the Sind, Punjab and Delhi Railway and interest charged to the Patiála State. When finished the line will be worked by the Sind, Punjab and Delhi Railway in the same manner as the Amritsar and Pathankot line.*

Country passed through.

The country passed through is the usual Punjab plain with a slight fall towards Patiála; there are no bridges, except over a canal and some small nullahs near that city, so that no engineering difficulties had to be encountered. The work made rapid progress and the line was opened in 1884.

Proposed extension to Bhatinda.

The project of continuing this line from Rájpúra to Kálka has not been revived, but instead it is now proposed to extend it in a south-westerly direction from Patiála so as to join the Rewari-Ferozepore line now under construction at some station between Sirsa and Ferozepore, probably Bhatinda. This extension, which would be on the metre gauge, would open up the Patiála State and a great deal of country now extremely inaccessible. The distance from Patiála to Bhatinda would be about 100 miles. For any through traffic there would be a break of gauge and consequent transhipment at Patiála.

Amritsar and Pathankot Railway.

State Railways in India are of various classes according to the manner of the provision of funds for their construction. What are known as Imperial State Railways are made with money found by the Imperial Government, generally by means of loans, for the special purpose; Provincial State Railways are constructed by local Governments, the interest on the capital borrowed, if it should be necessary to do so, being charged to the Provincial revenues, and the local Government getting the benefit of the profits of the line; and Native State Railways are undertaken by various States more or less independent, and paid for either out of surplus funds or by special loans on the responsibility of the Native State. The Amritsar and Pathankot Railway belongs to the second of these classes, having been undertaken by the Punjab Government which borrowed the necessary funds. This is the first line which

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* Since the above was written the line has been opened, and the Sind, Punjab and Delhi Railway has been bought by Government.

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Minor and Projected Railways.

History of the Work.

the Punjab Government has taken in hand, and the results of its working will materially influence the railway policy of the province.

The construction of the railway as a provincial productive public work was sanctioned in December, 1881; the line to be on the 5′ 6″ gauge, and it was estimated to cost Rs. 46,00,000 for its length of 66 miles. It is probable that the amount of the original estimate may be somewhat exceeded. The actual construction of the line was given out to contractors, under the supervision of the Public Works Department of the Punjab; the time fixed for completion was November, 1884, and a bonus was offered to the contractors for every month within that period, should the line be ready for opening earlier.

Good progress was made, and consequently the greater part of the line from Amritsar to Dinanagar, a distance of 51 miles, was opened for public traffic on January 1st, 1884. The remaining 15 miles from Dinanagar to Pathankot were opened a few months later.

Country passed through.

The line traverses one of the most fertile districts of the Punjab. At Amritsar, the great emporium of commerce, it forms a junction with the Sind, Punjab and Delhi Railway, and from that station runs in a north-easterly direction up the Bárí Doáb, or Mesopotamia of the rivers Biás and Rávi, through endless fields of grain abundantly irrigated towards the foot of the Himalayas. The district is thickly populated and the country closely studded with thriving villages. Twenty-four miles from Amritsar is the town of Batála with a population of 24,000; twelve miles further on are the Egerton Woollen Mills on the banks of the Bárí Doáb Canal, where large manufactures of cloth, blankets, &c., are carried on, the motive power being supplied by the Canal Falls; and at 43 miles from Amritsar Gurdáspur, the head-quarters of the district, with a population of 4,700. Eight miles from Gurdáspur is Dinanagar, a prosperous commercial town; its population is 5,589. Pathankot, the terminus of the line, is not so important for its own local trade as on account of its situation at the mouth of the celebrated Kángra Valley: here the road from Palumpur and Kángra, down which the vast quantities of tea grown in the valley are brought, leaves the hilly regions; here the roads from the military and hill stations of Dalhousie and Dharmsála, and also Chamba and Rámpur, converge. When the line is opened to Pathankot and in proper working order there is no doubt that a large and profitable traffic will be obtained. Possibly at some future day the line may be continued into the Kángra Valley; at any rate it seems desirable to extend it to Nurpur.

Method of construction.

In describing the Siálkot Branch of the Punjab Northern State Railway it was shown how that Branch, situated in a country liable to be flooded, had been constructed as a surface line, with the object of allowing a free escape for the water in every direction. The Amritsar and Pathankot line, which is very similarly situated with regard to the general direction of the fall of the country and liability to floods, has been made on the opposite principle of raising the rails on an embankment above the highest flood level, and providing bridges and culverts to allow of the equalizing of the water

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Method of construction.

on both sides, and thus preventing a dangerous accumulation. This method of constructing a high embankment has the great advantage that the traffic may be maintained, without interruptions caused by floods, for years together, or possibly even it may never be interrupted in this manner. There is, however, something to be said on the other side; the high bank is very costly, to begin with, so are the bridges; and an embankment is liable to special dangers. Thus if there is a rapid flow of water parallel to the direction of the railway its sides are very soon worn away; also every bridge and culvert is a source of danger; the swift rush of water through the opening may scour out the foundations and cause the fall of the bridge, as has often happened on other lines. Lastly, should an embankment be breached, it takes a considerable time to repair it.

The Amritsar and Pathankot Railway has been constructed in a very substantial manner, if not a very economical one, and to protect the slopes of the banks they have been covered with sods, which is very unusual in India. Except from its liability to be flooded, the country offered no difficulties to the engineer; the surface is nearly level with a slight gradual rise from Amritsar towards Pathankot. There are no works of any importance, except where the Bárí Doáb Canal is crossed at Dháriwál and again at Sarna by iron girder bridges of 130 and 146 feet span respectively.

Cost of line.

As already stated the estimate for the cost of the line was Rs. 46,00,000. This does not include rolling stock. There is very little doubt moreover that, as soon as the line is fairly at work, it will be found that further expenditure will be required to give the necessary facilities for traffic. The capital expended on a railway will invariably be found to increase year by year as the traffic expands and new wants arise.

Arrangements for working.

An arrangement was made by which the Amritsar and Pathankot Railway was worked by the Sind, Punjab and Delhi Railway as a branch of the latter Company's line, the necessary rolling stock being provided by the Punjab Government.

An agreement was drawn up to provide for meeting the cost of the various establishments, hire of rolling stock, &c., and payment of profits to the Punjab Government. This agreement of course lapsed on the purchase by Government of the Sind, Punjab and Delhi Railway.

Statistics.

At this early stage of the history of the Amritsar and Pathankot line, it would be worse than useless to give any statistics relating to it as they would only be misleading.

Umballa-Kálka-Simla Railway.

In the account of the Patiála State Railway from Rájpúra Station on the main line of the Sind, Punjab and Delhi Railway to the capital of that State, reference has been made to a proposal made by the Maharajah in April, 1866, to construct a railway at the cost of his State from Patiála to Kálka. Surveys were made but the scheme fell through at that time, and though it has been so far revived that the line from Rájpúra to Patiála has now actually been constructed, what might seem the more important part of it, *viz.*, from Rájpúra or Umballa to Kálka at the foot of the hills, is still in abeyance. Railway access to Simla is of great importance from an Imperial point of view, but it is by no means certain that it would be a

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Umballa-Kalka-Simla Railway.

profitable undertaking even if the line were carried no further than Kalka.

Several schemes have been prepared and surveys made for branches leaving the main line at different points but all having Kalka for their objective. The principal obstacle to be encountered *en route* is the Ghaggar river, an expensive bridge over which would be necessary if the branch originated at Umballa, but it might be avoided by leaving the main line west of the point where the Sind, Punjab and Delhi Railway crosses that river. This would, however, increase the railway distance from Umballa Cantonment to Kalka to 44½ miles instead of 39½, which it would be were the road followed. The adoption of the longer route would save some six lakhs of rupees.

The Director-General of Railways in his administration report for the year 1881-82 makes the following remarks on the proposed railway to Simla :—

"The practicabality of a mountain line of railway to connect Simla with the Sind, Punjab and Delhi Railway has several times been carefully considered. The country between Kalka and Simla is a most difficult one, not merely from its rugged character, but because the lines of natural drainage run across the direct line between the plains and Simla. The present cart road runs through three systems of drainage—the Sutlej, the Jumna, and the Ghaggar, the last river being a mountain torrent with a confined catchment area and flowing between the courses of the Sutlej and Jumna rivers eventually loses itself in the Bikanír desert. The first 16 miles of the cart road from Kalka run through the valley of the Ghaggar : from that point onwards the road may be said to run on the watershed between the Sutlej and Jumna all the way to Simla, 58 miles from Kálka, and for a further distance of 40 miles beyond Simla.

"The first idea that suggests itself for a railway to Simla is to creep up one of the natural lines of drainage, and thus by a gradual ascent to reach Simla; but a glance at a map illustrating the lines of drainage shows that this is impracticable; a line up the valleys draining into the Sutlej would entail a length of railway of about 250 miles in the hills before the plains are reached, and of about 150 miles if a line up the Jumna valleys be attempted. Considering that the old road from Kalka to Simla *viâ* Kasauli is only 42 miles in length, and that the present driving road is only 58 miles, a line of railway up one of the natural lines of drainage is out of the question. If then a railway is ever made the best route is apparently one keeping generally to the line of the new road. * * *

* * * * * * * * *

"It is estimated that a line of railway of the same character as the Darjeeling line, and taking generally the line of the present cart road, would cost at least 35 lakhs of rupees, and would be an extremely expensive line to maintain as the hills are formed of decomposing rock and slips are constant during the rainy season."

Ráwalpindi-Murree Railway.

Of all the Himalayan Hill Stations, Murree is the nearest approached by a main line of railway, being only 38 miles from Ráwalpindi by road. The first proposals for the construction of a

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Ráwalpindi-Murree Railway.

line were made in 1881 by private persons interested in the locality, especially the Proprietors of the Murree Brewery, a thriving concern which supplies the Commissariat very largely, and now spends a small fortune in cartage down from the hills. The proposal was favorably received by the Punjab Government which undertook the survey of the line. It has been ascertained that Murree can be reached by a line 46 miles in length with a maximum gradient of 1 in 30. Being a purely hill line a very narrow gauge is indispensable: the approximate estimates for a gauge of 2½ feet give a total cost of Rs. 19,30,000. The first 20 miles being on comparatively level ground would be constructed for less than half the cost per mile of the remainder, or purely hill portion. This line would terminate two miles from the centre of Murree and 400 feet below the Mall. The promoters of the railway are very sanguine as to their prospects of being able to raise the required capital.

As regards probable profits, reference will doubtless be made to the Darjeeling Railway on the two-feet gauge which earned 6·35 per cent. on its capital in 1881 and 5·17 per cent. in 1882. The circumstances are, however, not the same, except malt liquor there will not be much goods traffic, and a line which has to depend mainly on Europeans to support its passenger traffic is not likely to prove highly remunerative.

Bhera-Shahpur Railway.

The line known as the Salt Branch, starting from Lala Musa on the Punjab Northern State Railway, which was opened for traffic in 1880, was constructed in order to convey the salt from the mines at Khewra on to the main line as cheaply as possible. No sooner, however, had the line started working than a large and quite unexpected passenger traffic was met with. The branch which runs for fifty miles nearly parallel to the left bank of the river Jhelum is carried across it during the cold weather at a point near Miani by a temporary bridge, and from Pind Dádan Khán on the right bank there is a length of five miles to Khewra, where the mines are. During the rains through communication is interrupted. So profitable was the local traffic found that in 1882 the line was continued beyond Miani, still on the left bank of the Jhelum, ten miles further on to the town of Bhera. The country is level and favorable for railway construction at a very small cost, and various proposals have been made for further extensions in the direction of the frontier, a nearer approach to which in the neighbourhood of Banu and Dera Ismail Khán is equally desirable from a commercial and a military point of view. It has been proposed to prolong the line to the town of Shahpur 30 miles beyond Bhera; any further continuation would lead only into a sort of *cul de sac,* the apex of the Jetch Doáb; to get nearer the frontier the Jhelum has to be crossed. One idea is to take the line over the river at Khushab 16 miles beyond Shahpur, which is a favorable site and then to cross the Sind Ságar Doáb in a south-westerly direction to Bhakkar on the left bank of the Indus nearly opposite Dera Ismail Khán. This last section, 92 miles long, would lie entirely in the desert, and therefore be dependent on through traffic.

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Bhera-Shahpur Railway.

The other plan is to make a permanent bridge about Miani,* which would save the ferrying of the salt now necessary during the rains, and then skirting the Salt Range to take a more northerly route across the Sind Ságar Doáb to Darya Khán, a little above Dera Ismail Khán. By taking this direction the line would be rather longer, but would pass through several large villages, and only 14 miles of it would lie in actual desert. This line, if ever constructed, should carry the bulk of the Afghan trade now passing through the Gumal Pass, estimated at about Rs. 70 lakhs annually.

Ludhiána-Ferozepore-Bahawalpur-Patiála-Bhatinda Railway.

For some years past there has been a general consensus of opinion that a railway connection between Ferozepore and Ludhiána is required, and that it would be a very profitable undertaking; the line has been surveyed, estimates carefully framed, and statistics enough to convince the most doubting collected, but the first sod still rests secure in the earth. Efforts are, it is true, being made to raise the necessary capital from the public, but they do not at present seem likely to be attended with any great success. If a few capitalists would watch the traffic entering Ludhiána by the Ferozepore road their hesitation would probably vanish. Not only is Ferozepore a large military cantonment and the chief arsenal of Northern India, but it is the centre of one of the finest wheat-producing districts of the Punjab. According to the surveys and estimates which have been made this line would be 80 miles in length, passing through an exceedingly populous country with very light earth-work and no bridges, the total cost being about Rs. 40,00,000, not including rolling stock. This estimate is for a broad gauge line.

The Ludhiána-Ferozepore scheme and further extensions must necessarily be considered in connection with existing lines and others under construction.

The Sind, Punjab and Delhi Railway has lately opened a branch from Raéwind to the right bank of the Sutlej within seven miles of Ferozepore, but the crossing of the river is a serious obstacle to the traffic. The metre gauge line from Rewari is already opened as far as Ferozepore. Should a third rail be laid over the Bombay, Baroda and Central India Railway between Ahmedabad and Bombay it would then be possible to send grain to the latter port without any transshipment or ferrying, though Bombay is much further off than the natural port of the Punjab—Karachi.

Part of the Rewari-Ferozepore scheme is a branch from near Fáridkot to Fázilka, another large centre of trade on the left bank of the Sutlej below Ferozepore, also on the metre gauge. There is besides a proposal for bridging the Sutlej,† either for the broad gauge line, so as to make a through connection from Ludhiána to Raéwind, or for the metre gauge which would necessitate a transshipment at Ganda Singh. This bridge, which would be the third over the Sutlej, would be a very expensive affair, costing

* This project has actually been carried out since the above was written, and the Jhelum has been bridged at a place called Chak Nizam near Pind Dadan Khan. The line is carried down the right bank of the river as far as Khushab, whence it crosses the desert to Kundian in the Bannu District, from which point it follows the course of the Indus down to Mahmudkot opposite Dera Ghazi Khan.

† See foot note to page 213.

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Ludhiána-Ferozepore-Bahawalpur-Patiála-Bhatinda Railway.

probably as much as 70 miles of line; it has, therefore, been suggested as an alternative to abandon the Fáridkot-Fázilka branch which is not yet begun, but continue the broad gauge Ludhiána-Ferozepore line along the left bank of the river to Fázilka, and thence to Bahawalpur where it would join the Indus Valley State Railway and avoid crossing the river, besides opening up much new country; the distance from Ferozepore would be about 250 miles. One great merit of this line would be that it would give a communication between Delhi and Karachi free of all danger from floods; the Indus Bridge at Sukkur will be quite secure, but the two bridges at Phillour and Adamwáhan are founded on sand and a flood which breached either would close the line.

The Patiála State proposes to continue the line now under construction from Rajpura to the capital, so as to join Rewari-Ferozepore Railway at Bhatinda, thus traversing nearly the whole length of the State.

Delhi-Umballa Railway.

Allusion has been made in the account of the Sind, Punjab and Delhi Railway to the diversion of the railway from the straight line of the Grand Trunk Road between Delhi and Umballa to the other side of the Jumna, in order to take in Meerut and Saharanpur. This indirect route is 160 miles in length, or about 30 more than the distance by road. The proposals for constructing a chord line have not taken any practical form as yet, still there can be no doubt that sooner or later it will be constructed. There is a very large traffic on the Grand Trunk Road, and the district is thickly populated; the line would pass through the following towns:—

	Population.
Sonepat	13,077
Panipat	25,022
Karnal	23,133
Shahabad	10,218

The country is level, but towards Umballa some considerable bridges over the Markanda and other torrents would be necessary. The chord might rejoin the main line by way of Tháneswar and Patiála instead of at Umballa. No estimates have been made for either route.

Jullundur-Hoshiárpur Railway.

The town of Hoshiárpur, with a population of over 21,000 inhabitants, and the principal place in the district of the same name, is only 25 miles from the Jullundur station on the main line of the Sind, Punjab and Delhi Railway. It is not only an important place in itself but is situated at the point where the road from Lahul, Kulu, Palumpore, the chief town of the Kángra Valley, and Dharmsala, descends from the Siwáliks, and a great part of the products of the Kángra Valley are still brought by this route, though the opening of the new line to Patháukot partially diverted them. No definite proposals have ever been made for a branch from Jullundur to Hoshiárpur, but it is to be considered as a possibility of the future.

Sialkot-Jamu Railway.

On the 1st January, 1884, was opened the branch of the Punjab Northern State Railway from Wazirabad to Sialkot on the borders of the territories of the Maharajah of Kashmir. Now that the railway has been brought so near his frontier, the Maharajah

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Wazirabad-Jhang Railway.

is naturally ambitious to continue it to his winter capital, Jamu, a distance of some 25 miles. No estimates have yet been prepared; the line will, however, in all probability be taken in hand before very long and constructed at the expense of the Kashmir State.

The Rechna Doáb between the Rávi and Chenab rivers is entirely unprovided with railway communication. To give this large district a means of exporting its surplus products, a line might be constructed from Wazirabad through Jhang, traversing the whole length of the Doáb and reaching Multan by a bridge over the Rávi. This would give a length of some 250 miles through easy country it is believed, with no large works but the one bridge. Strictly economical construction on the metre gauge would be necessary to make the line a paying one. The towns passed through with their respective populations would be—

Ramnagar	6,830
Pindi Bhatian	3,528
Chiniot...	10,731
Jhang	9,055
Maghiana	12,574
Shorkot	2,283

SECTION E.—THE BÁRI DOÁB CANAL.

Bári Doáb Canal.

The Bári Doáb Canal occupies the upper portion of the tract of country between the rivers Biás and Rávi. This tract is, again, subdivided by the Páttí, Kasúr, and Hujrá drainage lines. The head of this canal is situated on the left bank of the river Rávi, about four miles below the point where it leaves the hills. It runs in one channel for nearly 30 miles, where, opposite the station of Gurdáspur, a branch is taken off, which seven miles further on is divided into the Sobráon branch for the irrigation of the land between the river Biás and the Páttí nalla and the Kasúr branch for that between the Páttí and Kasúr nallas. The main line then runs on for 24 miles, at which point it is divided into the main branch lower, for the irrigation of the country between the Kasúr and Hujrá nallas, which passes Amritsar, irrigates the Government forest at Chángá-Mángá, and flows back into the river somewhat to the north of Montgomery; and the Lahore branch for the tract between the Hujrá nalla and the river Rávi, which rejoins that river about 12 miles below Lahore.

Original project.

The project of the canal was undertaken, shortly after the annexation of the Punjab, in no small degree from political considerations. They are described in the Civil Engineer's Report of October 1851:—

"During the early period of annexation large bodies of Sikh soldiers, whose homes were in the Mánjha, were disbanded, and being thrown out of their accustomed means of livelihood had little encouragement to turn to agriculture in a country in which water for irrigation was at the same time so scarce and so indispensable. It became almost a matter of political necessity to open works which would give immediate employment to labourers and an early supply of water for irrigation."

At this time an old canal, said to have been first constructed when the country was under Mahomedan rule, was running from

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Original project.

the Rávi at a point close to the foot of the Himalayas as far as Lahore, a distance of about 100 miles, where it terminated in the Shalimar garden; a branch from it also supplied water to the sacred tank in the city of Amritsar. A considerable area of land, chiefly in the upper districts, was irrigated from it; but the alignment was so defective, and the obstructions to the drainage along its course so numerous, that it was considered unadvisable to attempt its rectification as a main channel supply. Portions of it were subsequently incorporated in the system of distributaries from the Bárí Doáb Canal; but a comparatively small proportion of the total length was even thus utilised.

The original project for the canal was drawn up in 1850. The estimated cost, exclusive of compensation for land, distributary channels, and tools, was Rs. 52,70,000. This estimate was sanctioned by the Court of Directors. The scheme provided for four branches, aggregating 466 miles of navigable channel, for a full-supply discharge of 3,000 cubic feet per second, and for the irrigation of an area of 654,000 acres. The probable receipts were calculated by Colonel Dyas, the designer, on the supposition that the canal would irrigate 654,000 acres at Re. 1, and earn indirect income in the form of enhanced land-revenue over 1,962,000 acres at 8 annas per acre. Its net income was to be Rs. 14,50,000, or 27·47 per cent. on the outlay. The indirect income was calculated on three times the area irrigable in any one year; experience on the Eastern Jumna Canal having shown that of the total irrigable area only one-third was actually irrigated in any one year: the total area, however, would come under the category of "highly irrigated," and be subject to enhancement of land-revenue. The returns were somewhat differently estimated by the Chief Engineer in the Punjab, Lieutenant-Colonel (now General Lord) Napier, who based his calculations on the water-rate then paid on the Hasli canal, which was subsequently amalgamated with the Bárí Doáb Canal system. He came to still more favourable conclusion, estimating the net profits at 27½ per cent. on outlay, exclusive of all enhancement of land-revenue due to irrigation.

History of the work.

The works were commenced in November 1850. Some alterations in the designs were found to be necessary, and the rates for labour and materials proved to be higher than was anticipated. A revised estimate was accordingly called for, which was submitted to the Government of India in 1856. The revised scheme provided for the same length of channel and discharge, but brought the estimated outlay up to Rs. 1,39,60,000, on which it was hoped that the canal would earn the interest and 12½ per cent. net profit to boot. No orders were issued on this estimate; but the works proceeded, and the canal was formally opened in April 1859, irrigation commencing in the following year.

Enlargement of the Scheme.

Shortly after the opening of the canal, it was found that the volume of water obtainable from the Rávi for the winter crop was on the average much less than the amount calculated in designing the works. For the summer crop the full supply of 3,000 cubic feet was ordinarily available; but the winter crop being the staple in

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The Bari Doab Canal.

Enlargement of the Scheme.

the Punjab, it was evident that some alteration in the distribution was required. Defects also in the channels similar to those on the Ganges Canal (the most serious of which was the excessive declivity of bed in the main line, which caused a velocity of current greater than the soil could stand without dangerous erosion) called for rectification; and the difficulty of maintaining the canal supply by temporary expedients led to the project of constructing permanent works on the Rávi at the canal head. The possibility of supplementing the canal supply from the Biás river had been suggested years before; and the question was carefully investigated on the discovery of the deficiency in the Rávi supply. The probable cost of the project, however, proved to be so large that the idea was finally abandoned; and it was decided to use to the best advantage whatever water the Rávi could yield in both seasons. Proposals were accordingly submitted, of which the following were generally approved by the Government of India: (1) the maximum cold-weather supply of the Rávi to be utilised, a summer supply on a larger scale to be provided; no water to be taken from the Biás; (2) the capacity of the various channels, including the Kasúr and Sobráon branches, to be so adjusted as to distribute the available supply over the whole area; (3) navigation, as far as practicable, to be provided along the main lines of the canal. The measures finally approved for the completion of the canal works, as thus proposed, were communicated to the Secretary of State. The detail of the projected works included (1) permanent weir across the Rávi and head-work; (2) alterations of the central line of canal, so as to enable it to carry the full supply of water; (3) alterations of a portion of the Lahore branch; (4) completion of the distributary system on the lines of canal then open; (5) construction of the Kasúr and Sobráon branches; (6) completion of navigation arrangements along the central line from the heads to opposite Lahore, and across navigable line from Lahore to the Sutlej.

The average supply of water was estimated during the winter season at 1,850 cubic feet per second, in the summer at 3,000 cubic feet per second, the quantity calculated on in the original project. One of the main deviations from the revised scheme of 1856 was the abandonment of the lower portion of the central line, 121 miles in length, which was originally intended to join the Rávi near Multan, but now terminates about 50 miles south of Lahore. The deficiency of water-supply from the Rávi led to this change, as well as to the proposal to draw water from the Sutlej river below its junction with the Biás by a weir across it above Ferozepore. This would have supplied the tract in the lower portion of the Bárí Doáb. This project was subsequently drawn up and estimated for, but has been laid aside for the present owing to the large expenditure involved. Estimates for the first two items were sanctioned by the Government of India in 1868 and work commenced; and in May 1870 detailed estimates aggregating Rs. 22,04,000 were passed for the Kasúr and Sobráon branches, which had a short time previously been commenced as relief-works. These sanctions were

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The Bari Doab Canal.

Enlargement of the Scheme.

confirmed by the Secretary of State in August 1870. The total cost, exclusive of interest during construction of the canal, was then estimated at Rs. 1,77,40,000. The total irrigable area was estimated at 504,000 acres, and the probable earnings at about 8·3 per cent. on an outlay of nearly Rs. 1,80,00,000. A subsequent and more detailed estimate, submitted in 1874, put the total outlay at Rs. 1,83,30,000 or, omitting provision for navigation, Rs. 1,60,30,000, the irrigable area at 543,000 acres, and the length of navigable channel 192 miles. The estimated returns showed a profit of 8·82 per cent on the outlay if the works were completed for irrigation only; and 8·07 per cent if the navigable communication was also completed.

It was decided by the Government of India that the completion of the navigation-works should be deferred; and sanction was given to the remainder of the estimate, with an addition to the provision for establishment, which raised the aggregate outlay from Rs. 1,60,30,000 to Rs. 1,62,25,000. The intention of making any part of the channel navigable has now been abandoned, and the total estimated cost to completion is at present given at Rs. 1,65,00,000. The supply of water calculated on is from 1,850 to 2,600 cubic feet per second in the winter season and 3,000 cubic feet, occasionally reaching a maximum of 3,600 cubic feet, in the summer. The excess of the final estimate over that of 1856 is, to a large extent, owing to the addition of items such as the permanent head-works which have since been considered necessary, or which it was not then customary to include in canal projects. The canal was ready and in working order by the end of 1859-60, and irrigation from it commenced in the following year. The head-works, however, were at first only of a temporary nature, and were not completed till 1872-73. They consist of a permanent weir across the river, with scouring and regulating sluices on the left flank. The works for rectifying the main channel are nearly finished, but as a considerable portion can only be carried out when the canal is closed, the progress is necessarily slow. The estimated supply is maximum 3,600, minimum 1,800 cubic feet per second; and the area protected by the canal is about 54,300 acres. The length of the main line is 1,489, of the branches 205, and of the main distributaries 862 miles. The total direct and indirect outlay on the canal up to 1st April, 1883, was Rs. 1,55,26,000. A statement is appended giving the chief revenue statistics of the canal for the last six years.

The water (occupiers') rates, from which the main part of the direct income is derived, are assessed at the following rates per acre:—

For overflow—

	Rs.	As.
Class I.—(Sugarcane)	6	0
„ II.—(Rice and gardens)	4	12
„ III.—(Sundry crops)	2	8
„ IV.—(Ditto)	1	8
For single watering on fallow	0	12

For lift,—one-half the above rates.

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The Sirhind Canal.

Enlargement of the Scheme.

These rates came into force in 1870-71. The old rates were uniform for all crops :—

	Rs.	As.	P.
For overflow	2	6	8
" lift	1	3	4

The average of the new rate does not in practice materially differ from that obtained by the old rate.

Year.	Districts.	Area Irrigated.			Income from Occupier's rate.	Expenditure during last six years.
		Kharif.	Rabbi.	Total.		
1877-78	Lahore	38,877	99.452	133,829	2,30,480	5,23,987
	Amritsar	33,525	69,002	102,527	2,13,996	
	Gurdáspur	13,262	12.877	26,139	63,379	
	Total ...	85,664	181,331	266,995	5,07,855	
1878-79	Lahore	61,454	119,780	181,234	3,49,459	5,14,358
	Amritsar	38,847	81,395	120,242	2,86,107	
	Gurdáspur	16,162	9,920	26,082	98,410	
	Total ...	116,463	211,095	327,558	7,33,976	
1879-80	Lahore	72,078	129,598	201,674	4,10,413	5,02,288
	Amritsar	56,207	99,634	155,841	3,57,218	
	Gurdáspur	21,151	14,651	35,802	1,22,736	
	Total ...	149,436	243,881	393,317	8,90,367	
1880-81	Lahore	72,504	149,687	222,191	4,16,491	4,22,718
	Amritsar	57,886	117,221	175,107	4,09,349	
	Gurdáspur	20,714	15,068	35,782	1,28,163	
	Total ...	151,104	281,976	433,030	9,54,003	
1881-82	Lahore	68,034	133,106	201,140	4,83,146	5,10,565
	Amritsar	41,769	95,937	137,706	4,12,591	
	Gurdáspur	17,069	12,087	29,156	1,17,684	
	Total ..	126,872	241,130	368,002	10,13,421	
1882-83	Lahore	75 326	113,601	188,927	4,63,605	5,29,573
	Amritsar	52.525	82,331	134,856	4,05,091	
	Gurdáspur	18,620	11,212	29,832	1,14,348	
	Total ...	146,471	207,144	353,615	9,83,044	

SECTION F.—THE SIRHIND CANAL.

The Sirhind Canal.

Extending in a south-westerly direction from the foot of the Siwáliks, and bounded by the valley of the Jumna on the east, by that of the Sutlej on the north and west, and by the Bíkánír Desert on the south, is a large tract of country comprising the British districts of Umballa, Ludhiána and Ferozepore in the north, the Feudatory States of Patiála, Nábha, Jind, Maler Kotla and Farídkot in the centre, and the British districts of Sirsa and Rohtak in the south. Along its northern border the rainfall averages about 28 inches yearly, and is, as a rule, well distributed in moderate falls throughout the monsoon and cold weather. Several torrents, such as the Saraswati, the Márkanda, the Ghaggar, the Sarhind and the Patiála nallas, rising in the lower ranges of the Himalayas traverse in a south-westerly direction the eastern portion of this tract, and gradually disappear as they get farther and farther away from the hills. As permanent sources of water-supply they are of little

The Sirhind Canal.

value, because, although they flow to a considerable distance when in flood, yet even in the rainy reason their channels are often nearly empty, and during the rest of the year most of them are quite dry at a distance of 20 miles from the foot of the hills. The north-eastern portion of the tract of country under description, lying between the hills and the Sindh, Punjab and Delhi Railway, is well supplied with water, and is highly cultivated; but, as the distance from the hills increases, the rainfall diminishes, the depth to the spring-level becomes greater, expanses of sandy waste are more and more frequent, the villages are farther apart, trees are scarce and stunted, and at last cultivation fades away on the northern borders of the great desert. The inhabitants of the southern portion of this tract are mostly Sikhs of fine physique and industrious habits. Every shower of rain is taken advantage of to plough and sow their land; but, owing to the fact of general and well distributed rain being of rare occurrence, a good crop throughout the district cannot be reckoned on more than once in four years. Yet the fertility of the culturable soil is great, and the population being entirely agricultural, a plentiful supply of water alone is needed to turn a thickly-peopled arid tract into a populous grain-growing country.

First proposal for Canal.

The advantages to be derived from irrigating this portion of the country have long been recognised, and a report on the possibility of doing so by utilizing the flood-waters of the Ghaggar was called for by the Sudder Board of Revenue in 1836. The project which was submitted in 1837 was not approved. In 1840 a scheme for throwing a dam across the Ghaggar in the Sirsá District was proposed, but came to nothing. In the same year the first suggestion for a perennial canal from the Sutlej was made by Captain Brown, who was then engaged on the Revenue Survey of the Sirsá and Bhatinda Districts, and in the following year a report was submitted by Colonel Baker showing that an immense tract was suitable for irrigation, that the introduction of water from the Sutlej was practicable, and that sufficient information had been obtained to allow of an opinion being formed as to the benefits and cost of the scheme. Nothing definite resulted from these proposals, but from this time forward projects of irrigation from the Ghaggar lost favour, and the construction of a canal from the Sutlej became a fixed idea. Various projects were from time to time brought forward, but the scheme was for the time being abandoned, the reasons being want of funds and the improbability of any of the independent States through which the canal would have to pass joining in the project.

Project of 1856, 1862 and 1868.

With the exception of a report on the Ghaggar and Sarassutí, which was called for in 1850, the subject seems to have been in abeyance until 1856, when a proposal was made by Colonel Dyas, R.E., to construct a canal with a head near Rúpar to irrigate British territory. This project also was fruitless, but a great deal of valuable information was obtained, and its publication probably gave rise to the request of His Highness the Maháráj́ah of Patiála in 1860 to have the whole subject re-examined by English engineers

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Project of 1856, 1862 and 1868.

with a view to supplying irrigation to his own territories. The result was the submission in 1862 of an estimate by Colonel Crofton, R.E., amounting to 73 lakhs of rupees, for a canal taking out of the Sutlej near Kíratpur and flowing past Rúpar and Sirhind, nearly on the alignment of the old Muhammadan Canal, which is said to have flowed for one season, when a change in the river left the head dry, and it was never re-opened. This project, however, was not sanctioned by the Government of India, as the alienation of the water of a river in which British subjects had a direct interest was considered to be wrong in principle. In 1867 it was decided that an estimate should be prepared of the cost of the best scheme which the engineering knowledge of the day could devise, for utilizing the whole of the cold weather discharge of the Sutlej in irrigating the arid tract of country on the left bank of that river, irrespective of territorial divisions. In 1868 a project, in accordance with these views, was submitted, and having received approval, an estimate for the construction of the Main Line of the Sirhind Canal was sent up in 1869, and subsequently estimates for the entire scheme were submitted by Colonel Gulliver, R.E., in 1871.

Description of the Canal.

The Sirhind Canal, whilst its primary object is to irrigate the country between the Grand Trunk Road and the Ghaggar river and between the Sutlej river and the Patiála nallah, is also navigable; and if ever boat traffic is developed in Upper India, this canal will form the highway between the two great systems of Northern Rivers, those which flow into the Arabian Gulf, and those which discharge their waters into the Bay of Bengal. As it flows partly through British territory and partly through Native States, the canal system is divided into three parts—the first comprising the Main Line; the second the British Branches; and the third the Native States Branches.

Cost.

The cost of the Main Line, including all charges, is 206 lakhs of rupees, which is borne approximately in the proportion of two-thirds by the British Government and one-third by the States who are shareholders in the canal. The cost of the British Branches, 129 lakhs, is borne entirely by the British Government; whilst that of the Native States, amounting to 72 lakhs, is paid by the contributing States in proportion to the area irrigable in each. The total cost of the canal including all charges, abatement of land revenue, interest, &c., is 407 lakhs of rupees, of which 278 lakhs are paid by the British Government and 129 lakhs are met by contributions from the Native States. The charges for works, exclusive of loss of land revenue, leave and pension allowances, interest, &c., are—

Main Line.	*British Branches.*	*Native States.*	*Total.*
164 lakhs	101	70	335
Or British	...	...	... 210 lakhs.
Contribution	...	...	... 125 ,,

The head-works.

The head of the canal is situated about a mile from the town of Rúpar and at the point where the Sutlej leaves the Siwáliks and enters on its course through the plains. The works consist of a weir 2,400 feet long, with a crest 6 feet above the normal bed of river (R. L. 865·0 above mean sea level), and extending from the

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The head works.

foot of the high cliffs on the right bank of the river to within 330 feet of the left bank. This latter space is occupied by the under-sluices consisting of 12 openings each 20 feet in width, fitted with double gates, each 5 feet in height. The draw caused by these openings ensures the deep channel being in front of the canal regulator, and the regulation of the supply in the canal is assisted by raising or lowering these sluice-gates. Adjoining and at right angles to the under-sluices is the regulating bridge. Its function is, by the opening or closing of its gates so to regulate the amount of water that the quantity actually required and no more shall at any moment be passed into the canal. A lock channel is placed 550 feet up-stream of the regulator, forming the navigation entrance from the river.

Main Line.

Before mentioning other works of importance in the neighbourhood of Rúpar, it is necessary to give a short description of the Main Line or the first length of 39 miles. Taking off from the river, as before described, above the town of Rúpar, the canal sweeps boldy round in the 2nd mile between the town and the hills, and flows for 12 miles in a south-westerly direction through the *khádir* of the Sutlej. There having attained a sufficient elevation with regard to the level of the country, it strikes into the high bank of the river, and makes for the highest point of the country which it is proposed to irrigate. The Main Canal is 200 feet wide at bed level, and in the first three miles it passes through cuttings varying from 30 feet to 46 feet in depth. The bed in these miles is nowhere less than 14 feet below spring level, and the excavation was effected with considerable difficulty. The spoil from the first two miles was run in tip-wagons hauled by locomotives to the low ground bordering the river, and on the up-stream side of the canal it formed a strong defence for the head-works. The slope of the bed of the Main Line is 1 in 8,000, and the depth of water in it will vary from 6 feet during the cold season to 9·8 feet during the rains. At the former season it will carry 3,000 cubic feet of water per second with a velocity of 2·4 feet, and at the latter 6,000 cubic feet with a velocity of 3 feet.

Rúpar bridge.

After leaving the river, the first work is a bridge crossing the canal opposite the town of Rúpar. It consists of seven spans of 46 feet each; the roadway is 44 feet above the bed of the canal. The next work of importance is the Budki super-passage, which carries the combined streams of the Sugh and Budki torrents across the canal. The aggregate catchment area of these two torrents is 86 square miles, and their combined discharge 30,000 cubic feet per second. The super-passage is 400 feet wide between the parapets, which are 12 feet high. The water in flood is about nine feet deep on the floor of the aqueduct, the cost of which was Rs. 12¼ lakhs. A long diversion-cut leads the Sugh into the Budki above the super-passage, and a short cut on the down-stream side conducts the floods to the river. In the 7th mile another super-passage carries the Síswán torrent over the canal. It is a similar but smaller work than that above described; its cost (with training

Budki super-passage.

Síswán super-passage.

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works) was 9 lakhs. It is designed to pass 20,000 cubic feet per second, and is 250 feet wide between parapets, which are 10 feet high. Unusual difficulties were met with in laying the foundations of this work, and its construction was laborious and expensive. In the 11th mile a large syphon passes a drainage under the canal, and in the 12th mile there is a regulating bridge and escape-head. Any water in the canal which is in excess of requirements can here be returned to the Sutlej. Shortly after passing the 13th milestone, the last of the cross drainages is met with, and the waters of a comparatively small nallah are passed under the canal by a syphon. The remaining drainages from the high land are ponded by the canal spoil, and arrangements have been made by which surplus water from these reservoirs can be passed into the canal.

Dohar syphon, Chamkaur regulator and escape.

Lower works.

From this point onwards, the works presented no particular difficulties in construction, as the bed of the canal is above the spring level. Various bridges cross it at intervals of about four miles, the most important being the bridge carrying the North-Western Railway in the 37th mile, and that under the Grand Trunk Road in the 38th mile. The bridge at mile 31½ has monolithic arches of concrete. At a distance of 39 miles from the head the Main Line ends. The canal at this point is crossed by a regulating bridge for the purpose of dividing the water between the British and Native States branches.

Materials used on the Main Line.

The works on the Main Line are constructed of sandstone obtained from a quarry near Nálágarh, at the foot of the Himalayas; the arches are of brick burnt at Rámpur at the 36th mile from Rúpar. The mortar consists of *surkhi* manufactured from the bricks of the ruined walls and palaces of Sirhind, and of lime from kankar found on the top of the high bank of the river about 2⅓ miles east of the Budki super-passage and near the village of Patarheri. To distribute the large quantities of materials at the sites of the various works, a Railway of 5 feet 6 inch gauge was laid down over a total length of 54 miles. It starts from the North-Western Railway at Doráha, and thence runs along the canal-bank to Rúpar, 36½ miles distant. At a point six miles from Rúpar there was a branch since dismantled about three miles long to the Patarheri kankar quarries. From Rúpar the line is carried with steep gradients and sharp curves to the stone quarries near Nálágarh, distant 14 miles. The traffic over this railway was at one time very heavy, taxing to the utmost the 8 locomotives and 170 wagons of which the rolling-stock consists. One more source of supply of stone has yet to be mentioned. Near Kíratpur about 22 miles by river above Rúpar, boulders were collected along the bed of the Lohand nallah. A tramway was laid from the edge of the river to a point four miles up the nallah, and the stones delivered in trains of 25 or 30 trucks by gravitation. The boulders were carried down the river to Rúpar in boats and used in the construction of the weir and of the super-passages.

Workshops.

For the repairs of the engines and machinery in use on the canal, a workshop and foundry was erected near the regulator at

Rúpar Jails.

Rúpar. The whole of the lock and regulator gates, with their fittings and gear, have been built in these shops, and work has also been done for other canals in the Punjab. At Rúpar, too, the experiment of employing convict labour on Public Works was made on a large scale. At intervals of one mile, three Jails were built capable of holding in all 2,500 men. The prisoners rarely reached this number, but there were usually from 1,400 to 1,800 on the works. Their services were of great value, as their presence ensured the placing of a large body of men on any urgent work, and it also tended to steady the rates of free labour. The Jails indeed proved a most valuable institution, and contributed materially to the completion of the canal.

Combined Branches.

As before stated, the main line bifurcates at its 39th mile-stone, and the western branch flows through British territory. This channel, which is called the Combined Branches, carries two-thirds of the water brought down by the main line. Its bed is 160 feet wide, and its depth varies with the season from 6 feet to 9·5 feet. After a course of only two miles it also bifurcates, the northern channel being known as the Abohar and the southern as the Bhatinda Branch. The distribution of water to these two branches is effected by a regulating bridge at the termination of the Combined Branches.

Abohar Branch.

The Abohar Branch commences with a bed width of 88 feet, which is gradually diminished to 24 feet at the tail. Its depth varies from 4·8 feet to 7·4 feet at the upper end, and from 3 feet to 6 feet at the outfall. The discharges at the head of the branch are 1,027 and 2,041 cubic feet per second. It terminates after a course of 127 miles in an artificial tank or storage reservoir, which covers an area of 4½ square miles; and from this tank a distributary channel will afford irrigation for a further distance of 15 or 20 miles to the borders of Bíkanér territory. The fall in the surface of the country between the head and the tail of the Abohar branch is 226 feet, of which 104 is overcome by 15 masonry falls, and the remainder by the slope of the bed. Besides bridges at each of the falls, there are 12 separate crossings for important roads. Additional means of communication will be provided as found necessary. Locks are provided at the falls on the upper 48 miles of this branch, as this length forms part of the navigable channel between the Sutlej and the Jumna. There are in all ten such locks.

Sutlej Navigation Channel.

Near the 48th mile-stone is the head of the Sutlej Navigation Channel. This is a cut which connects the Abohar Branch with the Sutlej, and tails into the river at a point six miles above Firozepore. It is 47 miles long, and it has a uniform bed width of 30 feet. It is provided with eight locks, and has also a lock at the head, and a stop-lock with weir and scouring sluice at the tail. Although a discharge of 150 cubic feet per second only is considered necessary for purposes of navigation, the channel is constructed to carry 400 cubic feet, so that it can be used to some extent as an escape channel. It is crossed in its 34th mile by the road from Firozepore to Ludhiána.

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Bhatinda Branch.

The general direction of the Bhatinda Branch is parallel with, but south of the Abohar Branch. Starting with a bed width of 84 feet and a depth of water varying from 4·6 feet to 7·4 feet, it decreases during the 100 miles of its course to 24 feet in width, with from 3 feet to 6 feet of water at the tail. This branch is less advanced than any of the others, and it will not be ready for opening for at least another year. As in the ease of the Abohar Branch, the excess of slope in the surface of the country has been overcome by means of vertical falls; the bridges have been provided with sufficient headway for navigation, but locks have not as yet been built. With this addition the branch would be navigable throughout.

Feeder Line.

The Native States Branches are three in number, and are known as the Kotla, Ghaggar and Choa Branches. There is also a short navigation channel up to the city of Patiála. From the end of the Main Line a channel called the Feeder Line runs in a southerly direction. It is carried at right angles to the drainage of the country, and as it crosses each water-shed, a branch takes off and runs down the high ridge. The principal drainages crossed are the Lissára, the Sirhind and the Choa nallahs. The first of these has a catchment area of 250 square miles, and it is passed under the canal in its 12th mile by a syphon of 4 spans of 14·5 each, with 4 feet height to springing. The second rises in the low hills, and drains an area of 450 square miles. It is passed under the canal in the 27th mile by a syphon designed to carry 13,000 cubic feet per second. The syphon consists of 9 barrels, each of 25 feet span, and 6 feet high to springing. The third of these drainages is also passed under the canal in the 40th mile by a syphon consisting of 6 barrels and providing a waterway of 392 square feet. This nallah drains a basin of 180 square miles. The whole length of the Feeder Line is 41 miles. At the head its bed width is 75 feet, its depth of water varies from 6 feet to 9·3 feet, and its discharge from 1,100 cubic feet to 2,100 cubic feet per second. As, however, the successive branches are taken off, these dimensions decrease until at the tail its bed width is 30 feet and its depth from 4 feet to 6 feet. It is crossed by seven bridges and three regulators, and in continuation of it, the Patiála Navigation Channel, a still water canal, six miles long, connects it with the city of Patiála. The channel flows close to the town, and the ground between the channel and the town is laid out as a promenade.

Lissára Drainage.

Sirhind Nallah.

Choa Nallah.

Patiála Navigation Channel.

Kotla Branch.

Commencing from the head of the Feeder Line the first branch flows near the city of Kotla, the chief town of the State of Máler Kotla, and which gives its name to the branch. Taking off from the Feeder Line in the 14th mile, the Kotla Branch flows generally parallel to, and at a distance of from 15 to 18 miles from, the Bhatinda Branch; its course lies principally through Patiála territory. Its length will be 90 miles, its bed width at the head 50 feet, and at the tail 20 feet; whilst the depth of water will vary at the head from 4·6 to 7·4 feet and at the tail from 3 feet to 6 feet. It will carry at the head from 616 cubic feet to 1,225 cubic feet of water per second, diminishing gradually as expended to but a small volume

at the tail. The difference of level between the upper and lower ends is 165 feet, of which 82 feet are overcome by 11 masonry falls. This branch is still under construction.

Ghaggar Branch.

At 15½ miles measured on the Feeder Line below the head of the Kotla Branch is the regulator at the head of the Ghaggar Branch. This branch passes near the town of Nábha, the Capital of the State of that name, and flows chiefly through Patiála territory and parallel to the Kotla Branch for its entire length of 53 miles. The bed of this branch is intended to carry from 277 to 582 cubic feet of water. There are six masonry falls with bridges and four separate bridges on this branch.

Choa Branch.

The last of the branches is the Choa taking out of the Feeder Line in the 41st mile. But little irrigation is contemplated from this branch, and its principal use will be as a head to the navigable channel, which will hereafter connect the Sirhind and Western Jumna Canals. Its length is 25 miles, its bed width uniformly 30 feet, its depth of water varies with the season from 4 feet to 6 feet, and its discharge from 149 to 284 cubic feet. Like the Ghaggar Branch, it tails at present into the Ghaggar River. It will be provided with four locks. Its course lies almost entirely through the Patiála State.

Western Jumna Navigation Channel.

The construction of this channel has not yet received sanction, and although it was proposed as part of the general scheme of the canal, it has not been accurately surveyed, or its alignment definitely fixed. On its course it will cross both the Ghaggar and Sarassutí torrents. As the crossing of the Sarassutí will be the lowest point of the bed, the water for the channel beyond that stream will be supplied by the Western Jumna Canal. The dip down to the Sarassutí from either end of the channel will be about 35 feet, necessitating the introduction of probably four locks on each section.

Nature of work on Branches.

The whole of the works on the branches are built of bricks burnt at the site of the works, and of mortar composed of line and *surkhí*, also prepared at site. The lime is made from nodular kankar which is easily obtained of good quality over the whole country through which the canal passes. Fuel was everywhere very scarce, and this necessitated in many cases the burning of bricks in *upla* clamps and of lime by charcoal. In the construction of the works on the branches no engineering difficulties were experienced, the foundations being at all sites dry, except in the case of the Sirhind and Choa nallah syphons, and some of the works near the tail of the Feeder Line and the tail lock of the Sutlej Navigation Channel. Underlying the surface soil, which is clay or clayey loam, an almost indefinitely thick stratum of fine clean sand was everywhere met with, and in this sand the greater part of the foundations of the works on the branches are laid. The supply of labour towards the tails of the branches has given great trouble. The country is thinly peopled by an agricultural race, and the discomfort for strangers of residence in it is so great that immigration is in disfavour. Work-people cannot be induced to travel long distances for work in a

General nature of foundation on Branches.

Supply of labour.

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district where the brackish water is from 150 feet to 200 feet below the surface of the ground, where the nearest wells are sometimes four or five miles away from the work, where there is no shelter for themselves or fodder for their goats and donkeys, where the rain-fall is scanty, the heat great, and every breeze is laden with blinding sand.

No irrigation from Main Line.

The primary object of the canal is, as has been already stated, the irrigation of the thirsty tracts through which it passes. The bed of the Main Line being below the surface of the country, there will be no irrigation from it, and none indeed is needed. From the branches only are distribution channels or rájbahás taken off, and from these again at suitable points minor channels will lead the water amongst the fields which are to be irrigated. The distributaries are channels of varying length, according to requirements, carrying from 40 to 200 cubic feet of water per second. They leave the canal invariably above a fall, where the surface of the water is higher than that of the country, and strike away for a distance of about five miles. Then turning they run generally parallel to the canal for about 15 to 30 miles, ultimately either flowing back into the canal below a fall, or tailing into other rájbahás. They are aligned on the water-sheds between the smaller drainages of the country, and the surface of the water in them is kept higher than that of the surrounding land. As before stated, at suitable points, smaller channels branch off from the main distributaries, and it is from these that water is delivered on to the fields. Through their banks wherever required culverts will be made, and the water will flow from them into the water-courses or *kháls* formed by the cultivators. The rájbahás are supplied with numerous masonry works, such as bridges, syphons and culverts for passing the drainages, falls for overcoming the excess slope of the country, &c. These works, although individually small, yet from their large number form no inconsiderable item in the cost and labour of constructing the canal. On an average there is about one such work per mile of rájbahá, and the total length of the main rájbahás will probably be not less than 2,000 miles. These rájbahás are most of them now under construction.

General description of distributing channels.

Minor Rájbahás.

Total length of channels.

The lengths of the various channels are here shown in canal miles of 5,000 and in statute miles of 5,280 feet—

	Canal miles.			Statute miles.
Main Line	39		=	36·9
Secondary channels (Combined Branches and Feeder Line)	43		=	40 7
Branches, British; Abohar and Bhatinda ...	225	394	=	373
Branches, Native States; Kotla, Ghaggar and Choa	169			
Navigation Channels	54		=	51·1
Rájbahás, probably	2,000		=	1,893

Or a total length of 2,530 miles of channel, large and small, exclusive of the Jumna Navigation Channel, which is not yet commenced.

Area commanded by irrigation and branches.

The area comprised in the whole system of the canal is 8,476 square miles, of which 4,100 lie in British territory, 2,920 in the Patiála State, 620 in Farídkot, 496 in Nábha, 148 in Jínd, 164 in

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Area commanded by irrigation and branches.

Máler Kotla, and 28 in Kalsia. Of this area 5,528 square miles are commanded by the British, and 2,948 by the Native State Branches. It is estimated that 522,000 acres will ultimately be irrigated by the British, and 261,000 acres by the Native Branches. The revenue which it is expected will be derived from the British Branches after deducting the cost of maintenance amounts to 17 lakhs, which will give a percentage on the capital invested (exclusive of interest during construction) of about 7½ per cent. The Native States will have the management of their own irrigation, and it is hoped that a similar return will accrue from their management.

Plantations.

The plantations will, it is hoped, in time prove a valuable source of revenue. The whole of the spoil and spare land belonging to the canal is everywhere sown with the seed of timber trees, and the plantations will be carefully tended and preserved.

Water-power.

From the numerous falls along the branches the canal will possess a fund of energy not easily exhausted. It is probable that flour-mills will soon be erected at some of the falls near main roads and large towns. It is to be hoped that at some of the falls on the branches factories similar to those that have already been erected on the Bári Doáb at Dháríwál and at Sujánpur may in time be constructed. The advantages offered at the sites on the Abohar Branch are greater than those on the Bári Doáb, since this canal is navigable up to the railway, and both the raw material and the manufactured articles will be cheaply transported.

SECTION G.—THE WESTERN JUMNA CANAL.

The Western Jumna Canal.

The Western Jumna Canal takes its supply of water from the main river at Hathni Kúnd, where the river finally debouches from the hills on its western bank. The new head-works are situated on the right bank of the Jumna at Tájáwála about a mile and a half below the point where the river leaves the Siwáliks, and consist of a permanent weir across the river bed, with scouring and regulating sluices on the right bank.* By this weir nearly the whole stream, of which about one-third has already been carried off for the Eastern Jumna Canal, is turned into the Budhi Jumna through a short artificial cut. It flows for some distance in this channel, and is then turned off, by another artificial cut, into the bed of the Pathrála torrent. The Pathrála shortly joins the Sombh, and just below the point of junction, at a place called Dádupur, the united river is crossed by the dam which turns the water into the canal. The canal diverges at an acute angle from the Sombh, and the water is admitted through a regulator on the western bank of that river. The dam is 777 feet in length, and consists of a series of masonry piers, three feet in thickness with openings ten feet wide. When it is required to stop the water back into the canal, these openings are closed by boards; while by the removal of the boards, the whole

* Similar sluices on the left bank supply the Eastern Jumna Canal from the same weir.

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The Western Jumna Canal.

water of the river can at any time be allowed to escape down the bed of the Sombh, and thence into the Jumna. The regulator of the canal has ten openings, four of 16 feet, and six of 10 feet in width, which can be closed, when required, by sluice-gates, working with a windlass from above. After a slight fall of 1½ foot, the water flows on in the artificial bed of the canal. The discharge during the floods varies of course every year; and it is so great as to render it impossible to make an exact calculation. The estimated discharge of the highest known flood, that of the year 1844-45, was 365,032 cubic feet per second, with a mean velocity of 18·092 feet per second. The present estimated supply is max. 2,800 and min. 2,000 cubic feet a second passing down the Canal.

The old Canal.

The first public work, of which record remains, in connection with irrigation from the Jumna, was a canal, constructed about the middle of the fourteenth century by the Emperor Fíroz Sháh Tughlak.* Shams-i-Siráj Afíf, the historian of this monarch's reign, after describing the foundation of Hisár Fíroza† relates that "the Sultan, perceiving that there was a great scarcity of water, resolved in his munificence to bring a supply thither (*i.e.*, to Hisár). He accordingly conducted two streams into the city from two rivers; one from the river Jumna, the other from the Sutlej. Both these streams were conducted through the vicinity of Karnál, and after a length of about 80 *kos*, discharged their waters by one channel into the town." It may be pointed out here that the reading adopted by Sir H. Elliot, which gives the Sutlej as the name of the second river from which a canal was conducted, is probably erroneous. All three of the extant MSS. mention that the canals were brought from two rivers, but only one mentions the Sutlej. The fact distinctly recorded, that both canals were brought past Karnál, is of itself sufficient to prove that neither could have come from the Sutlej. For such a canal, in order to reach Karnál, would have to cross at right angles the whole of the drainage of the lower Himalayas lying between the Sutlej and the Jumna, and the beds of all the torrents already mentioned. The distance, again, 80 *kos*, or about 160 miles, is quite inconsistent with Sir H. Elliot's reading, the distance between Karnál and the nearest point of the Sutlej being alone 100 miles in a straight line. It is impossible to determine what the second river was; but, in all probability, it was the Sombh. The distance of 160 miles, allowing for the winding of the canal, which, for the greater part of its course, follows the beds of natural water-courses, accords very well with the distance between Hisár and the point where the Jumna and the Sombh leave the hills. This theory is further borne out by the wording of a *sanad* of the Emperor Akbar, which states that "Fíroz Sháh Bádsháh * * * brought water from the 'nallahs' and drains in the vicinity of Sádhaura, at the foot of the hills, to Hánsi and Hisár." It is hardly necessary to add that no traces of a canal from the Sutlej in the direction of Karnál are extant. There is, indeed, a bed of an old canal, known

* History of India—Sir H. Elliot (1871), Vol. III, p. 300.
† See Gazetteer of Hisár district.

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The old Canal.

as that of Mirzá Kandi, which cuts diagonally through the Rúpar tahsíl, from near the Sutlej, towards Bassi in the Patiála territory. But this canal was dug in the Imperial times, about 150 years ago. It is said to have commenced far up in the district, where the Sutlej leaves the hills. But no trace of it is now visible so far north. Its course was nearly due south, running from just below Rúpar to Sirhind.

The precise position of the head of Fíroz Sháh's canal* cannot be determined, but in all probability it coincided in the main with that of the present Western Jumna. It followed one or other of the natural channels that intersect the low-lying land on the bank of the Jumna, as far as Karnál; and then was led by a short excavation into a line of drainage connected with the Chautang, the bed or valley of which is traceable to its junction with the Ghaggar. It appears to have terminated in a small masonry tank a short distance beyond Hisár; and the absence of any trace of water-courses along its banks seems to show that it was little used for irrigation.† Two hundred years later, this channel, having become choked, was re-opened by orders of the Emperor Akbar. The *sanad* which records this event has been already quoted. It is printed as an Appendix to Major Baker's memo. on the Western Jumna Canal. It recites that the canal had already become so choked that for the last hundred years its waters had not flowed past the boundary of Kaithal, and that from Kaithal to Hisár the bed was scarcely discernible. The work of restoration was completed about the year 1568, by Muhammad Khán Tarkhán, upon whom the title of "Míráb" was conferred in commemoration of the exploit. About the year 1628, a branch was taken off from the old canal by Ali Mardán Khán, the great Engineer of the Emperor Sháh Jahán, for the purpose of conveying water to the new city of Delhi erected in that reign. Another branch was, at the same period, carried in the direction of Rohtak. The maintenance of the water-supply, however, then as now required constant labour; and more attention than, amid the cares of a falling empire, was likely to be accorded to it. The canal gradually silted up, and, ceasing to flow about the middle of the 18th century, remained in disuse, until re-opened under British rule. In 1817, after much correspondence, and more than one preliminary survey, an officer (Lieutenant Blane of the Engineers) was appointed to effect the restoration of the Delhi branch. The water again entered Delhi in 1820. The restoration of the Hisár branch was commenced by Colonel Colvin in 1823, and two years later (in 1825) water was turned down it. Irrigation from the canal commenced in Hisár, during the season of 1826-27. It was not, however, generally taken advantage of until the famine year of 1832-33.

Present Canal.

The total length of canal now open is 433 miles, of which the main line includes 102 miles, with an aggregate of 259 miles of

* The history of the canal is very fully gone into in an able memorandum, drawn up in 1849, by Major W. E. Baker, R.E., to which the Editor is indebted for much of the information contained in the following paragraphs.

† Major Baker's Memorandum already alluded to.

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distributing channels, besides private water-courses for conducting water to fields. From Dádúpur, as far as Karnál, a distance, in a straight line, of 40 miles, the canal takes a winding course, parallel in the main to that of the river, and below the high bank which marks the termination of the low alluvial land that fringes the river side. This space is intersected throughout with old channels, and through the most western of these the canal has been directed. Hence the winding nature of its course. Opposite Karnál, the river bends southwards; and the canal, maintaining its course towards the south-west, passes through the high bank of the river by a cutting six miles below Karnál. The Delhi branch strikes off at Rer, 14 miles below this cutting, and, running due south, passes through the city of Delhi and terminates in a junction with the river. Eleven miles below the head of the Delhi branch, the Rohtak branch leaves the canal, and passing Rohtak loses itself in a tract of sand to the south of that town. A third branch, known as that of Butána, strikes off 3½ miles below the head of the Rohtak branch, at the village of Joshi, and dividing into two branches ends 27 miles from Joshi, and a few miles beyond Butána, the town from which it derives its name. From Joshi, the point of divergence of the Butána branch, the canal follows the line adopted by the Engineer of Fíroz Sháh, evidently that of a natural nallah as it can not be supposed that a line freely selected would have been so tortuous. Twenty miles in a straight line from Joshi, the canal meets the Chautang Nadi, the bed of which is utilized for the remainder of its course. It flows south-west as far as Hánsi; then, turning slightly northward, it passes the town of Hisár, and dividing into two branches—the Darba branch, which is artificial, and the Bahádra branch, which follows the bed of the Chautang—finally ends in the sands beyond the border of Hisár. In exceptional seasons a small quantity of water finds its way to the Ghaggar.

History of construction.

Thus the canal is a restoration of an old Mahomedan work, improved and extended by the British Government. The main channels were generally on the old alignments; but, except in the city and neighbourhood of Delhi, very few old masonry works were in existence at the date of restoration, and the old channels appear in many places to have been obliterated. The total length is 433 miles, of which 290½ are on the old alignments and 142½ are new. Of both old and new alignments, a considerable portion lay in natural channels or drainage lines. Thus 84 miles of the main line ran in old channels of the river Jumna; 130 miles of another branch, the Hánsi, lie in natural drainage hollows, or the old bed of the Chatang river; and the first 22 miles of a third branch, the Rohtak, in another drainage line. This accounts, in a great measure, for the small expenditure on the restoration of the channels.

The restoration of the line from the head on the Jumna river to Delhi, 177 miles in length, was commenced in 1817; irrigation commenced in 1819, and water entered Delhi in May 1820. The work then contemplated was nearly completed in 1821; but the scheme was limited to the maintenance of a small supply of water in the Delhi branch, and included no embankments and only one

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bridge. Water was allowed to flow into the old channel of the Rohtak branch in 1821, but no attempt was then made to restore it. The restoration of the Hánsi branch was sanctioned in 1822; work commenced in March 1822, and water was admitted in May 1825. The line strikes off from the main canal about midway on its course, and flows in a south-west direction through Jínd to Hánsi. The Hánsi scheme included the restoration of a line to Rohtak and the construction of two new minor branches. Work was commenced on the Rohtak branch in 1825. Another line, the Butána, was constructed in 1835 to irrigate villages near the borders of the Jínd territory to which water could not be supplied from the Rohtak Canal.

Many old water-courses for the distribution of the water from the canal channels were in existence at the date of the restorations, the proprietary right to which appears to have been well understood. These were first utilised; and when the necessity for new water-courses arose, the right of passage through other village lands was secured by an order of Government, which also ruled that a village so intersected by a water-course was entitled to as much water from it as it could utilise with one baling basket worked by two men. All expenses on these water-courses, old or new, were defrayed by the village-communities. Subsequently the systen of *rájbáhás*, or main distributaries, to supply two or more villages, was introduced: these were constructed and maintained by Government at the cost of the village-communities until the year 1865, when it was decided to construct and maintain distributaries as an integral portion of the canal system at the expense of Government, the charges for water being at the same time increased. When the demand for irrigation increased and the Hánsi branch was re-opened, the channels restored in 1821 were no longer equal to the conveyance of the required quantity of water. It became necessary to embank them nearly from end to end, and to build bridges, the depth of water being too great for loaded vehicles to pass through.

The next stage in the history of the canal was the substitution of a masonry dam across the hill torrents intersecting the main line near the head, in lieu of a temporary earthen embankment which was carried away every year during the summer rains, This was sanctioned in 1830, and completed in 1833. In 1847-48 Captain Turnbull, R.E., submitted the first scheme for remodelling the canal, but no action was taken upon it. Minor additions and improvements to the works were made in the course of years, but no material alteration or extension of the channels took place. Some small cuts were made at different times to carry off local accumulations of drainage water; but it was not until the lapse of about thirty years after the opening of the canal that the swamped condition of a large portion of the canal irrigated tract drew attention to the necessity for extensive remedial measures. Some years subsequently the difficulties and risks in maintaining the canal-supply throughout the year by the old system of temporary embankments across the river, which had been continued since the restoration of the canals, led to the suggestion of permanent head-

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works; and the substitution of a complete system of properly aligned main distributaries for the numerous irregularly laid-out private water-courses was seen to be a necessity, as well to prevent wastage as to admit of draining the irrigated lands. Instructions were accordingly issued by the Government of India in 1864 for a full investigation into the condition of the canal, and recommendations were invited for measures calculated to remedy its defects. The report was submitted in the following year, and comprised proposals for improvements to the main line, the Rohtak branch, and a portion of the Hánsi branch, with permanent head-works, a complete system of main distributaries, and drainage works. The cost was roughly estimated at about Rs. 38,40,000. This report was forwarded to the Secretary of State; and in a despatch, dated 24th March, 1866, sanction was conveyed to all except that portion of the scheme which embraced the realignment of the canal; this, it was considered, might be postponed till there had been time to observe the effects of the other improvements. No increase to the supply of water then carried by the canal was contemplated. The full supply was about 2,000 cubic feet per second, rising occasionally to 2,500 cubic feet.

In the year 1867, the Inspector General of Irrigation submitted proposals for extending the scope of the canal system, by a series of new channels, to carry a monsoon supply to the dry tracts to the westward, lying out of the influence of the existing irrigation, and for modifications in the mode of dealing with the old works. The maximum supply available was calculated at 5,000 cubic feet per second in the summer season, 2,000 cubic feet in the winter; and of the latter, 1,500 cubic feet was allotted to the existing irrigation. Navigation was to be provided for from the regulating works at Dádupur to Delhi, and a navigable junction from thence to the new Agra Canal nine miles below the city. The Inspector General estimated roughly that these works might cost from fifty to seventy-five lakhs; that the additional area of irrigation would be about 350,000 acres, on which a net income of Rs. 2-8 per acre would yield Rs. 8,75,000, or 12 to 16 per cent. on the outlay. The scheme was transmitted to the Secretary of State in January 1869.

In October 1869 a portion of one of the new branches to the westward was commenced as a relief work, famine being then apprehended in those districts. This was approved by the Government of India, and subsequently by the Secretary of State in a despatch of May 1870. When the details of the project came to be elaborated, it was evident that the aggregate cost would much exceed the rough estimate of Rs. 7,50,000. A report was consequently submitted showing approximately the cost of the projected works. This estimate amounted to Rs. 1,29,00,000. The returns on this expenditure were variously estimated at from 12 to 14 per cent. The papers were forwarded to the Secretary of State in September 1871, and sanction was requested to the portions of the scheme involving an outlay of Rs. 66,80,000. In reply, sanction was conveyed to the immediate carrying out of those portions only

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of the project which concerned permanent head-works, distributaries and drainage-works. The remainder of the proposed works, including the new branches to the westward, were to be for the present deferred. The new head-works were accordingly commenced, and the preparation of the detailed designs and estimates for the distributary system and drainage were put in hand. In working out the latter, it became evident that, without radical alterations in the old system of main channels, it would be impossible to effect the main object of the proposed works, *viz.*, draining the irrigated tracts. This led to the proposal to construct an altogether new main line from above Karnál to near the city of Delhi, carried along the watershed, the old line in the valley of the Jumna being relegated to its natural use as a drainage line, and the outfalls on the highland below being at the same time freed from obstruction. This measure, with a properly laid-out system of main distributaries, would, it was expected, render a comparatively small outlay necessary on drainage-works. These views met with the approval of the Government of India; and the project, as thus altered, was sanctioned by the Secretary of State in despatch No. 65, dated 16th July 1874.

Final Scheme.

The final project included permanent head-works on the Jumna; a new main line taking off from the old channel about 15 miles above Karnál, and terminating at the 28th mile in new regulators for the Delhi and the Hánsi branches; a new channel in substitution for the first 55 miles of the former branch; the remodelling of the last twenty miles of that branch; a navigation line, 9¾ miles in length, to connect the Delhi branch with the Agra Canal lately opened; and drainage-works in the irrigated tract and improvement of the outfall into the river Jumna from the Najafgarh jhíls, the natural receptacle for the drainage from the southern portion of the irrigated districts. The distributaries from the existing Hánsi branch in the Native State of Jínd, which were included in the project of 1871, were omitted in the revised scheme, as it had not then been decided whether they were to be constructed by that State or by the British Government. It was resolved to abandon those portions of the old Rohtak branch which obstructed the natural drainage outfalls; the remainder were to be supplied by the new distributaries from the Delhi line. The cost of the above works was estimated at Rs. 72,20,000. In forwarding the project for the sanction of the Secretary of State, the Government of India remarked that the outlay would not increase the direct returns from the working of the Western Jumna Canal, though it was hoped that it would produce indirectly an improvement in the revenue. The main objects were sanitary: it was hoped, however, that, notwithstanding the proposed addition to capital, the Western Jumna Canal would still give a net annual return of not less than 13 per cent. on the total capital. The opinions of His Honor the Lieutenant-Governor of the Punjab and the local Revenue Officers on the proposed works were subsequently (in October 1874) communicated to the Secretary of State. They were unanimous in considering

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that the works of rectification of the existing canal should be carried out as speedily as possible. As to the projected channels for the conveyance of a monsoon supply to the dry tracts to the westward, which were excluded in the scheme last sanctioned, they were all of opinion that these branches would be of great benefit to those almost rainless tracts; but that they might, if necessary, be deferred until the more urgent work of rectifying the existing canal system could be carried out. The new head-works have been in use since 1878. The realignment of the main line has been completed, and the new system of distributaries nearly completed, and the work of opening out the drainage is now in active progress.

Financial working.

From the commencement till the year 1866 the water-rates on this canal were fixed, not so much by the real value of the water, as with the view of preventing waste, the Government looking only to the general improvement of the country as the source from which an adequate return on the outlay should be derived. From the winter season of 1866-67 the rates were more than doubled, and thus raised to nearly the same level as those levied on the Ganges Canal and elsewhere. The total outlay on the canal works up to the end of the official year 1881-82 amounted to Rs. 74,90,000. They protect an area of about 1,640 square miles. In 1877-8, a year of drought, the area actually irrigated was 507,974 acres.

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Financial working.

A tabular statement is appended, giving the chief Revenue Statistics for the last six years :—

Year.	District.	Area irrigated.			Income.		Expenditure during last six years.
		Kharif.	Rabi.	Total.	Owner's rate.	Occupier's rate.	
	Umballa	6,263	5,391	11.654		5 305	
	Karnál	51,041	72,526	1,23,567		2,10,988	
	Delhi	45,505	51,047	96,552		2,22,491	
1877-78	Rohtak	47,324	68,123	1,15,447		2,25,639	4,18,725
	Hisár	36.573	50.999	87,572	...	1,49.460	
	Native States ...	28,429	44,753	73,182		1,22,107	
	Total ...	2,15,135	2,92,839	5,07,974	...	9,35,990	
	Umballa	3,733	4.831	8,564		3,180	
	Karnál	46,970	50.364	97,334		2,28,972	
	Delhi	45,482	47,220	92,702		2,67,281	
1878-79	Rohtak	47,713	36,990	84.703		2,98,725	4,15,435
	Hisár ...	35.976	29,324	65.300	..	1,89,383	
	Native States ...	24,514	25,343	49,857		1,51,824	
	Total ...	2,04,338	1,94,072	3,98,460	...	11,39,365	
	Umballa	3,492	3,103	6,595		2,947	
	Karnál	37,950	39,077	77,027		2,67,964	
	Delhi	39.788	11,985	51,783		2.37,699	
	Rohtak	37,181	24,680	61,861		2,05,795	
1879-80	Hisár	32,784	28,696	61,480	1,12,238	1,39,349	4,75,632
	Gurgaon	...	...	...		2,578	
	Native States ...	22,967	28,973	51,940		1,11,121	
	Total ..	1,74,172	1,36,514	3,10,686	1,12,238	9,67,453	
	Umballa	3,994	1,158	5,152		7,4 1	
	Karnál	37,407	24,873	62,280		1,29,826	
	Delhi	22,142	7,346	29,488		90,576	
1880-81	Rohtak	27,857	19,391	47,248	2,29,371	1,40,516	4,08,254
	Hisár	28,901	40.064	68,965		1,29,974	
	Native States ...	24,367	28,051	52,418		1,15,483	
	Total ...	1,44,668	1,20,883	2.65,551	2,29,371	6,13,776	
	Umballa	2,287	769	3,056		7,289	
	Karnál	36,367	33,116	69,483		2 37,490	
	Delhi	28,964	21,938	50,902		1,54,903	
1881-81	Rohtak	32,626	26,263	58,889	2,56,191	1,52,369	4,31,163
	Hisár	38,963	26,685	65,648		1,75,312	
	Native States ...	28,514	24,053	52,567		1,39,650	
	Total ...	1,67,721	1,32,824	3,00,545	2,56,191	8,67,013	
	Umballa	2,798	794	3,592		7,511	
	Karnál	39,095	47,940	87,035		2,03,274	
	Delhi	34,300	30,773	65,073		1,80.699	
1882-83	Rohtak	35,530	40,229	75,759	2,55,234	1,82,421	4,71,794
	Hisár	33,919	46.054	79,973		1,36,286	
	Native States ...	27,111	35,700	62,811		1,22,654	
	Total ...	1,72,753	2,01,490	3,74,243	2,55,234	8,32,845	

STATISTICAL TABLES.

No. 3.—Statement of Surveyed and Assessed Area in acres, 1883-84.

Districts.	Cultivated.				Uncultivated.				Total area assessed, columns 5 and 9.	Gross assessment.
	Irrigated.		Unirrigated.	Total.	Grazing lands.	Culturable.	Uncultur-able waste.	Total.		
	By Government works.	By private in-dividuals.								Rs.
Delhi ...	79,672	90,418	355,275	525,365	......	143,455	144,495	287,950	813,315	8,51,621
Gurgaon ...	55,079	78,437	675,899	809,415	......	263,344	167,648	430,992	1,240,407	10,97,813
Karnál ...	105,925	145,316	412,763	664,004	8,163	582,328	287,371	877,862	1,541,866	7,69,066
Hisár ...	87,255	12,692	1,193,992	1,293,939	44,547	799,791	127,151	971,489	2,265,428	4,27,484
Rohtak ...	110,991	8,417	786,926	906,334	5,198	166,790	68,671	240,659	1,146,993	9,48,343
Sirsa ...	......	31,887	834,378	866,265	......	990,766	68,266	1,059,032	1,925,297	2,57,373
Umballa ...	3,199	83,403	888,997	975,599	110,162	192,560	342,908	645,630	1,621,229	13,29,651
Ludhiána ...	......	115,321	616,067	731,388	11,085	67,928	71,337	150,350	881,738	11,07,361
Simla ...	......	686	10,028	10,714	14,487	11,637	12,157	38,281	48,995	15,069
Jullundur ...	......	237,981	425,959	663,940	1,750	91,961	97,517	191,228	855,168	13,18,464
Hoshiárpur ...	......	29,966	677,766	707,732	......	191,479	528,043	719,522	1,427,254	13,81,737
Kángra ...	......	174,512	464,288	638,800	......	94,997	882,663	977,660	1,616,460	7,88,695
Amritsar ...	125,951	215,172	423,336	764,459	4,551	99,236	138,375	242,162	1,006,621	10,42,612
Gurdáspur ...	27,047	126,957	667,116	821,120	......	92,160	252,800	344,960	1,166,080	11,97,845
Siálkot ...	......	559,731	343,265	902,996	22,815	124,119	203,629	350,563	1,253,559	12,32,769
Lahore ...	239,808	308,880	607,697	1,156,385	159,545	738,156	310,801	1,208,502	2,364,887	6,91,095
Gujránwála ...	......	451,393	154,921	606,314	373,491	394,223	312,086	1,079,800	1,686,114	6,48,778
Ferozepore ...	75,460	192,466	1,133,030	1,400,956	4,976	224,338	136,974	366,288	1,767,244	6,36,619
Ráwalpindi ...	......	34,421	1,186,495	1,220,916	......	316,800	1,622,400	1,939,200	3,160,116	7,30,056
Jhelum ...	......	24,960	940,160	965,120	414,720	280,960	728,960	1,424,640	2,389,760	7,18,493
Gujrát ...	......	264,050	510,894	774,944	34,654	257,197	172,233	464,084	1,239,028	6,52,899
Shahpur ...	62,407	274,248	220,858	557,513	796,912	1,156,890	496,773	2,450,575	3,008,088	4,20,786
Mooltan ...	326,057	97,732	94,833	518,622	103,815	2,917,462	245,462	3,266,739	3,785,361	5,87,842
Jhang ...	......	242,427	102,550	344,977	2,447,276	839,500	183,274	3,470,050	3,815,027	3,23,326
Montgomery ...	84,702	191,091	90,182	365,975	......	3,052,490	149,285	3,201,775	3,567,750	2,97,287
Muzaffargarh ...	236,002	146,950	......	382,952	169,026	924,504	511,525	1,605,055	1,988,007	5,77,610
D. I. Khan ...	......	569,949	243,786	813,735	817,321	3,024,080	1,294,378	5,135,779	5,949,514	5,07,408
D. G. Khan ...	269,522	258,047	485,551	1,013,120	87,321	1,068,959	646,606	1,802,880	2,816,000	3,68,970
Bannu ...	......	141,588	485,444	627,032	43,972	620,966	1,180,957	1,845,895	2,472,927	4,19,601
Pesháwar ...	......	180,286	667,104	847,390	......	330,959	422,644	753,603	1,600,993	8,66,039
Hazára ...	......	36,380	344,727	381,107	150,579	35,399	1,247,444	1,433,422	1,814,529	3,05,374
Kohát ...	......	29,258	230,300	259,558	40,848	393,507	1,209,924	1,644,279	1,903,837	1,33,369
Total ...	1,889,077	5,355,022	16,274,587	23,518,686	5,867,214	20,488,941	14,264,751	40,620,906	64,139,592	2,26,51,455

GAZETTEER

OF THE

PUNJAB

PROVINCIAL VOLUME

1888-9.

Compi[illegible] authority of

[illegible] GOVERNMENT.